*News about*

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# HYCAR 1051

offers fabrication advantages with significant physical improvements

Hycar 1051 is the high acrylonitrile polymer of a new series of three polymers that are a major improvement in nitrile rubber. All three produce superior end products. The other two, announced previously, are Hycar 1052, medium high acrylonitrile, and Hycar 1053, medium acrylonitrile.

These three polymers combine a range of oil and solvent resistance superior to other nitrile rubbers, providing improved tensile with higher elongation and lower moduli. Users are enthusiastic. They report reductions in mixing time and lower power requirements on mixing equipment. They also report better mold flow that reduces rejects, and better building tack for making rolls, tank linings, and similar products.

Samples of Hycar 1051, or the other two Hycar polymers in this series, are available with further information. To get them write Dept. CA-6, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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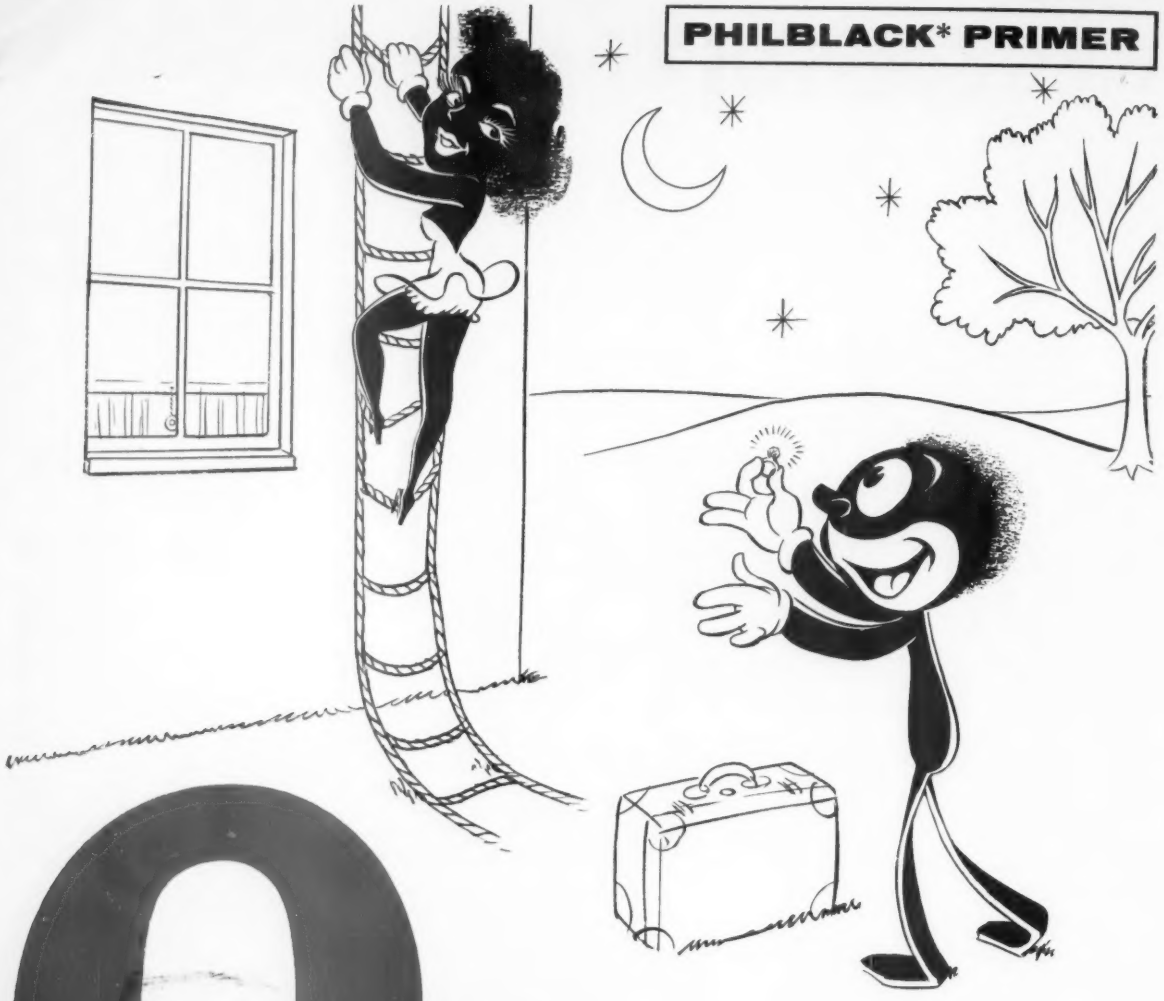

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# Rubber Age

COVERING THE MANUFACTURE OF RUBBER AND RUBBERLIKE PLASTICS PRODUCTS

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*Appears every other month


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# Highlights Sidelights *of the News...*

July, 1959

A subcommittee of the Senate Small Business Committee has concluded hearings at which independent tire dealers charged that present day tire sales practices are pushing dealers out of business . . . A bill recently introduced in Congress would prevent tire companies from selling directly to users and compel them to channel sales through local dealers (page 628).

The Federal Trade Commission has charged fifteen firms with conspiring to fix prices on tires and tubes . . . The complaint charges that the manufacturers have adopted and maintained a "single zone" price system which fails to give nearby buyers the natural freight benefit . . . In other charges, FTC stated that the tire firms exchange confidential information on prices and terms (page 630).

The Department of Justice has filed suit to force the Kennecott Copper Corp. to divest itself of the Okonite Co., which it acquired last fall . . . The suit charges that the acquisition may substantially lessen competition in the copper industry in violation of the Clayton Anti-trust Act . . . Kennecott has issued a statement declaring that the company is confident it has not violated any law in the acquisition of the assets of the Okonite Co. (page 628).

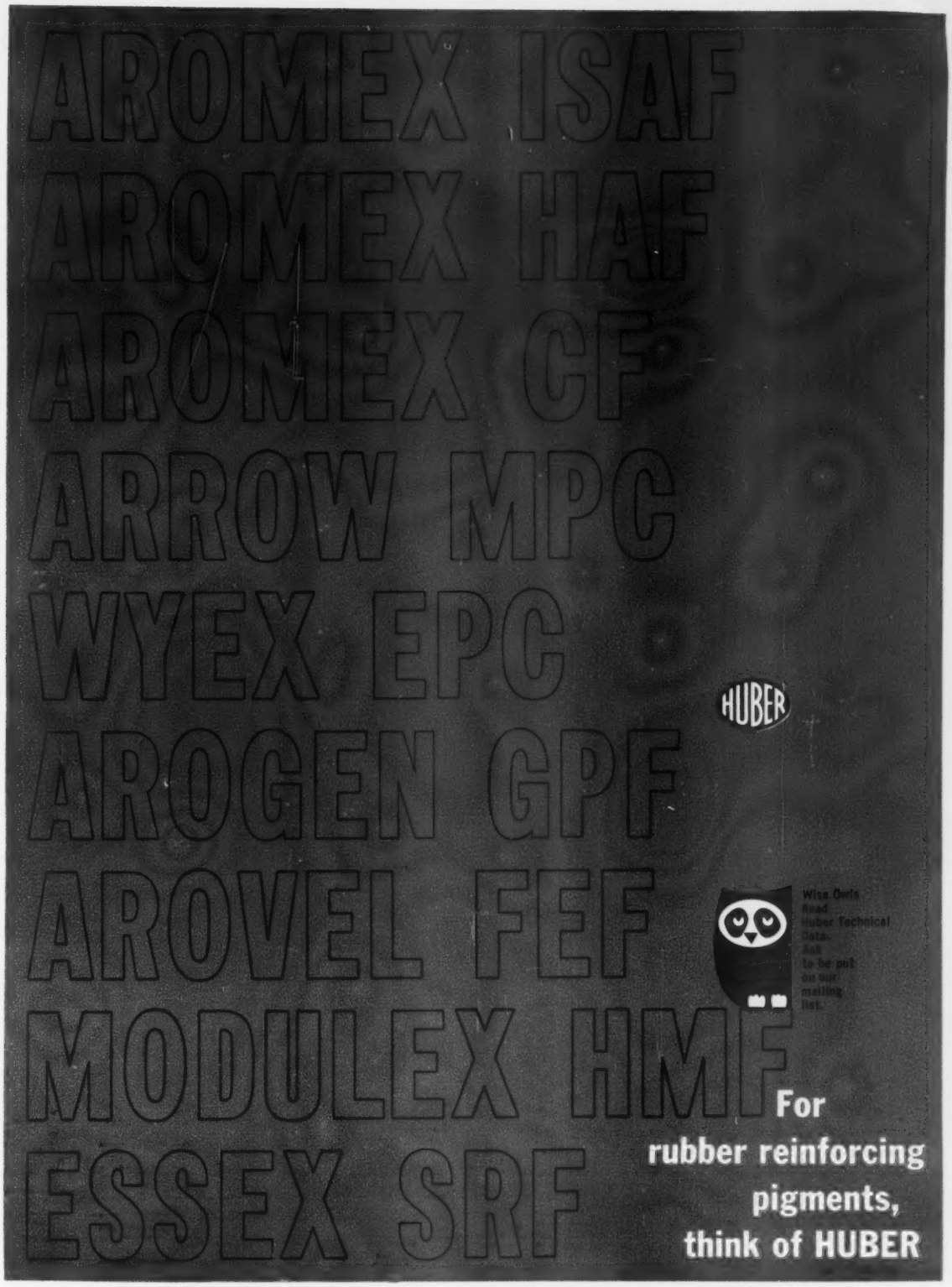
Dewey & Almy Chemical Division of W. R. Grace & Co. has opened a new plant at Owensboro, Ky., to manufacture polyvinyl acetate polymers and copolymers, butadiene-styrene latices, and battery separators . . . The new facility was constructed at a cost of $4 million (page 631).

The government's role in the technological development of the synthetic rubber industry recently came under the scrutiny of a Senate subcommittee . . . A report, issued in conjunction with the subcommittee's inquiry, prepared by Professor Robert Solo, is critical of many aspects of the government-sponsored synthetic rubber program (page 634).

Firestone Tire & Rubber Co. has settled its dispute with the United Rubber Workers in which working conditions and pension plans were the major issues . . . Three of the "Big Four" companies, including Goodrich, Firestone and U.S. Rubber, had been hit by the strike (page 630).

**Vacation Schedules**

As a service to the rubber industry and its suppliers, there appears in this issue a listing of those companies which have announced vacation schedules during which time plants will close or operate on curtailed schedules. See page 655.




Have you seen HUBER NEWS? We will be pleased to send you a copy of our quarterly magazine.

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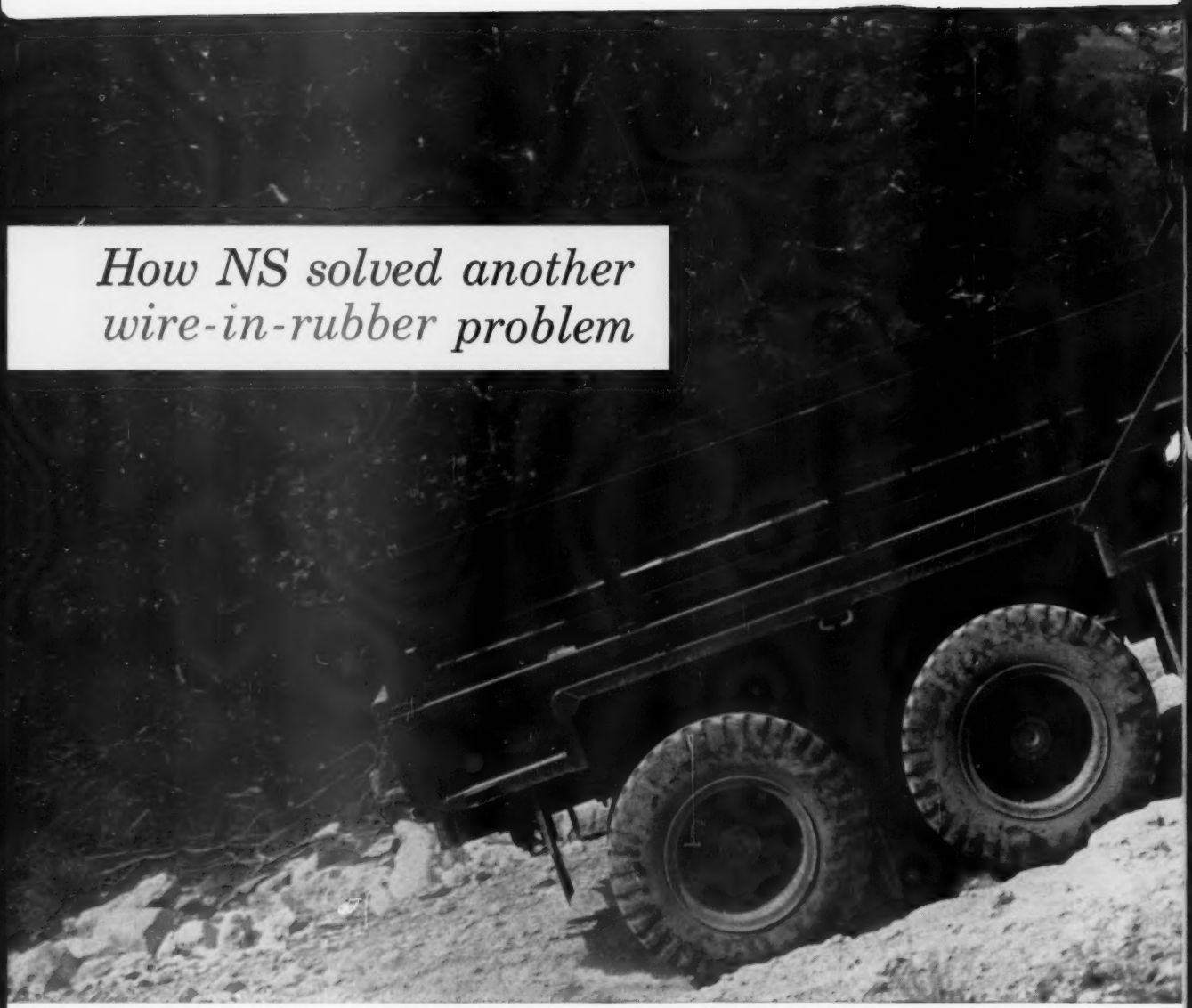

*How NS solved another wire-in-rubber problem*

# NATIONAL-STANDARD DEVELOPS SPECIAL BEAD WIRE FOR BUTYL TIRES

When several major tire manufacturers began experimenting with butyl rubber for passenger and military vehicle tires, a major problem was encountered—to develop a bead wire finish and butyl stock that provided the necessary adhesion.

NATIONAL-STANDARD engineers were called in by the tire manufacturers to develop a bead wire that would have the needed adhesive properties. Without such a bead wire, it would not be possible to utilize butyl in tires. Months of intensive experimentation and testing were spent by National-Standard engineers on a wide variety of metallic wire finishes, as well as fabricated braid and Pierce tape. These fabricated bead wires have proved particularly successful.

While their engineers in the laboratory at Niles, Michigan, were working on wire finishes and bead formations, National-Standard called in an independent research laboratory to find a butyl compound recipe that would give adhesion to bead wire finishes, and —at the same time—be compatible with the butyl stock used in the tire carcass.

RESULT—From these two concurrent research projects came the development of a bead wire and several butyl compounds which will provide satisfactory adhesion to meet tire manufacturers' special needs. Tire manufacturers have begun field testing of new butyl tires with National-Standard bead wire.

DEVELOPMENT ENGINEERING in new uses for wire in rubber products has made National-Standard the leader in this field for over 50 years. Wherever you have a wire-in-rubber problem, let National-Standard put their experience to work for you. For additional information write National-Standard Company, Niles, Michigan.

**TIRE TESTS** being conducted at proving ground on butyl tires for military vehicles show that butyl tires with new National-Standard bead wire hold up under rugged road conditions.

**BRAIDED BEAD WIRE** was subjected to stringent tests in National-Standard's laboratory to determine its adhesive properties with butyl.

Manufacturer of Specialty Wire for Rubber Products

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**DIVISIONS: NATIONAL-STANDARD,** Niles, Mich.; tire wire, stainless, music spring and plated wires • **WORCESTER WIRE WORKS** Worcester, Mass.; high and low carbon specialty wires • **WAGNER LITHO MACHINERY,** Secaucus, N. J.; metal decorating equipment • **ATHENIA STEEL,** Clifton, N. J.; flat, high-carbon spring steels • **REYNOLDS WIRE,** Dixon, Ill.; industrial wire cloth • **CROSS PERFORATED METALS,** Carbondale, Pa.; decorative, commercial, and industrial perforated metals.

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Photo courtesy Globe Rubber Products Corporation, Philadelphia, Pa.

# Fashion floor that's built for kicks

**Spiked heels may be stylish** on the foot, but they're "murder" on floors. Car floors, particularly, take a beating – not only from the pointed fashions of modern footwear, but from the constant pounding of foot-loose youngsters.

**To take it,** car floor covers or mats must be tough. And to sell, they must have color. One of the leading manufacturers in this field has found that PLIOFLEX, synthetic rubber by Goodyear, has the lasting qualities they require. It has also enabled them to make a more sales-appealing product at a substantial saving.

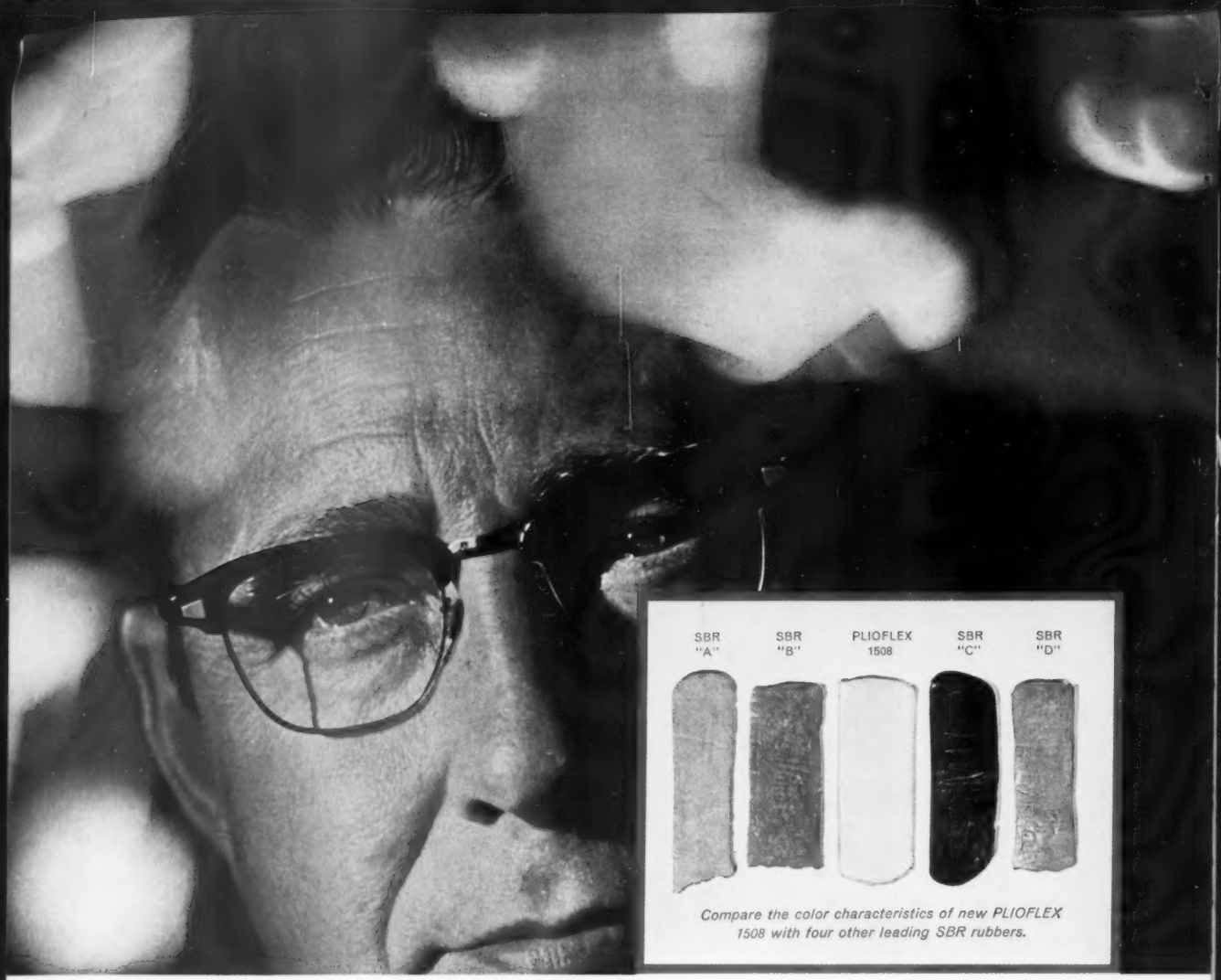
**Want proof? Just look** at the clean, crisp color of the floor mat above. Consider, too, the assured processability of PLIOFLEX *plus* its high uniformity and exceptional resistance to aging.

**It all adds up** to economical production of a sales-appealing product. To add appeal to *your* product without adding to your costs, check the advantages of PLIOFLEX. For full information–plus latest *Tech Book Bulletins* on PLIOFLEX and a full range of synthetic rubbers and rubber chemicals–write Goodyear, Chemical Division, Dept. G-9419, Akron 16, Ohio.

GOODYEAR

CHEMICAL DIVISION

Pliofilex–T. M. The Goodyear Tire & Rubber Company, Akron, Ohio




*Compare the color characteristics of new PLIOFLEX 1508 with four other leading SBR rubbers.*

# Thinking about better color?

## *This new "cold" rubber is for you!*

**What color sells best** in the rubber products you make? In most product lines, the trend is to light, bright colors. This applies particularly to *impulse* items, housewares, novelties. They must "stand out" on the shelf, catch the customer's eye, start the sale.

**That's why PLIOFLEX 1508,** new nonstaining "cold" SBR by Goodyear, is generating such interest in so many fields. For here is a low temperature polymerized, quality synthetic rubber with unprecedented lightness of color. With PLIOFLEX 1508, you can pick from a rainbow range of colors—and duplicate it, time after time, in your product.

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**Where can you use** this "cold" synthetic to warm up your sales? For more information on new PLIOFLEX 1508—and latest *Tech Book Bulletins* on the complete line of Goodyear synthetic rubbers and rubber chemicals—write: Goodyear, Chemical Division, Dept. G-9419, Akron 16, Ohio.

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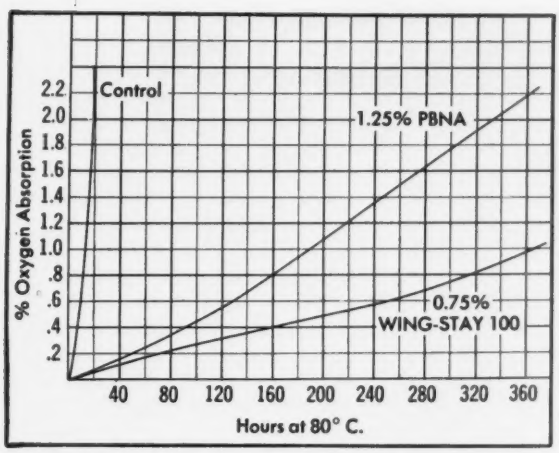
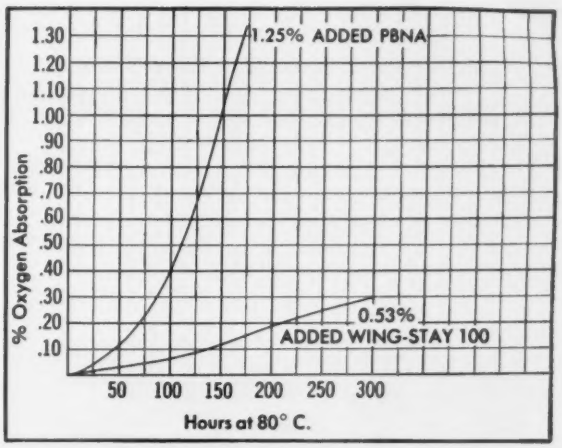
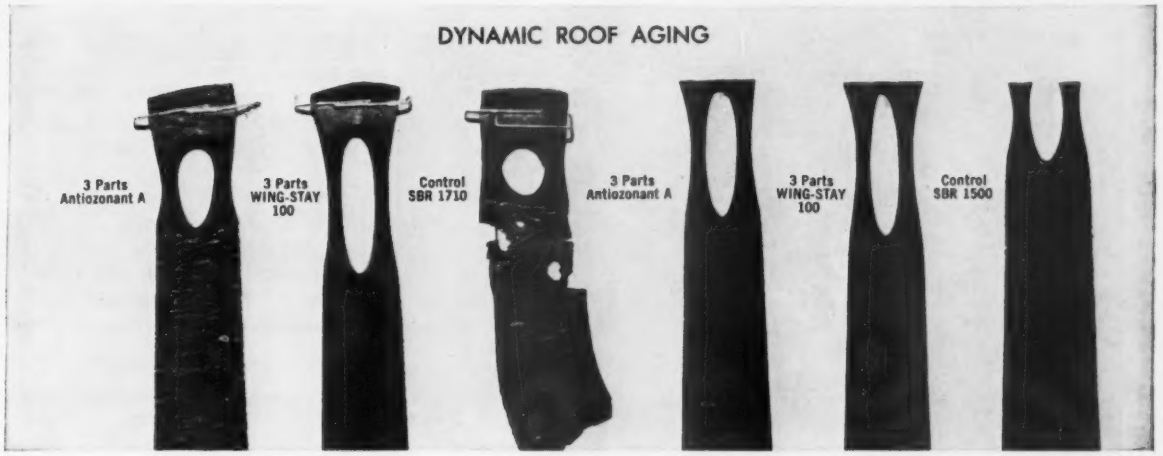
Pliolflex—T. M. The Goodyear Tire & Rubber Company, Akron, Ohio




Effect of WING-STAY 100 on the stability of an Oil-Extended SBR Polymer.




Effect of WING-STAY 100 as added stabilizer in a "cold" nonextended SBR Polymer.

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**The first truly effective combination of stabilizer, antioxidant and antiozonant for synthetic rubbers**

It's WING-STAY 100—an essentially nontoxic, nonvolatile, mixed diaryl-p-phenylenediamine that uniquely combines the more desirable properties of a number of commercially available age resistors.

As a stabilizer for discoloring-type styrene/butadiene rubber, Wing-Stay 100 gives excellent raw polymer protection and serves as a better building block for compounders at no extra cost.

As an additive to synthetic rubbers, Wing-Stay 100 provides these benefits: Easy incorporation. No acceleration of cure. No blowing at normal levels. Superior resistance to oxidative degradation and flex cracking. Outstanding antiozonant activity. Much better over-all protection at lower cost.

The charts and photographs above indicate the effectiveness of WING-STAY 100. But why not prove it to yourself with your own tests? Samples of WING-STAY 100 or PLIOFLEX rubbers containing it, plus full technical information, are yours by writing Goodyear, Chemical Division, Dept. G-9419, Akron 16, Ohio.

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Pliolex, Wing-Stay—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

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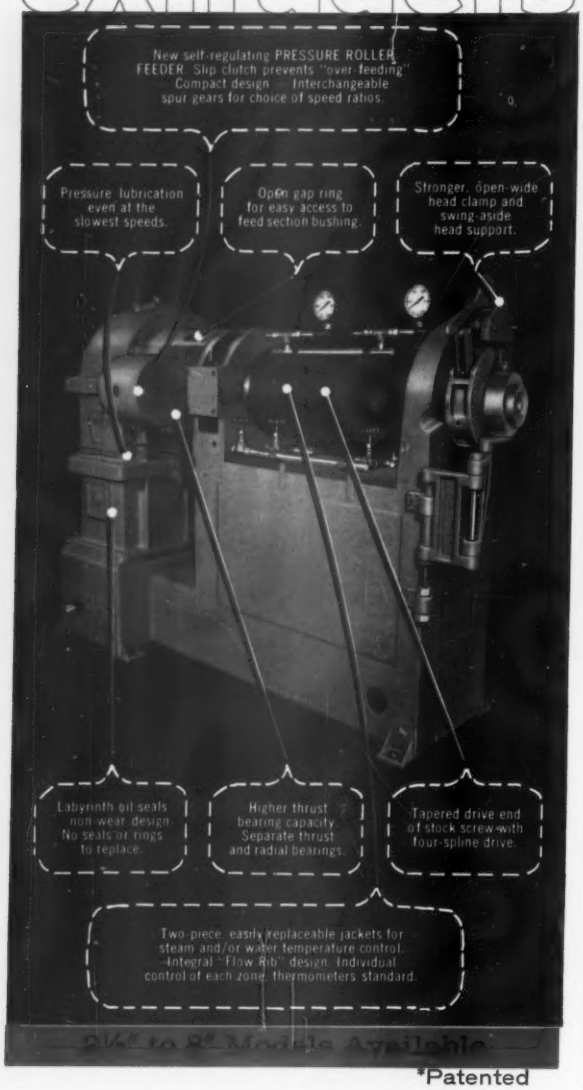
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# PATENT REVIEW

by Melvin Nord

## Butyl Rubber Dipped Goods

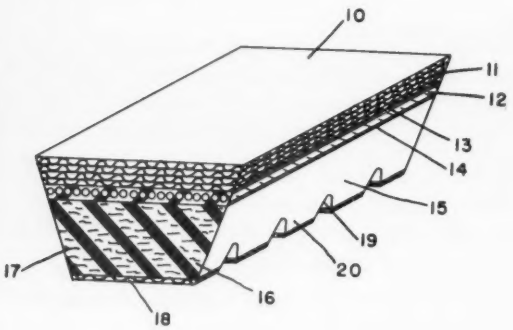
U.S. Patent 2,847,715, issued August 19, 1958 to Lucian P. Dosmann, assigned to United States Rubber Co., provides a procedure which enables the successful manufacture of dipped goods based upon butyl rubber.

The process involves forming an intimate mixture of butyl rubber, a substantial proportion of a filler, and a curative for the butyl rubber in an amount sufficient only to partially cure it. This mixture is masticated at a temperature above 300°F. to cause the curative to react with the butyl rubber and partially cure it. The partially cured mixture is then cooled to below 200°F., and a substantial amount of polyethylene and enough additional curative agent to finish the cure are added.

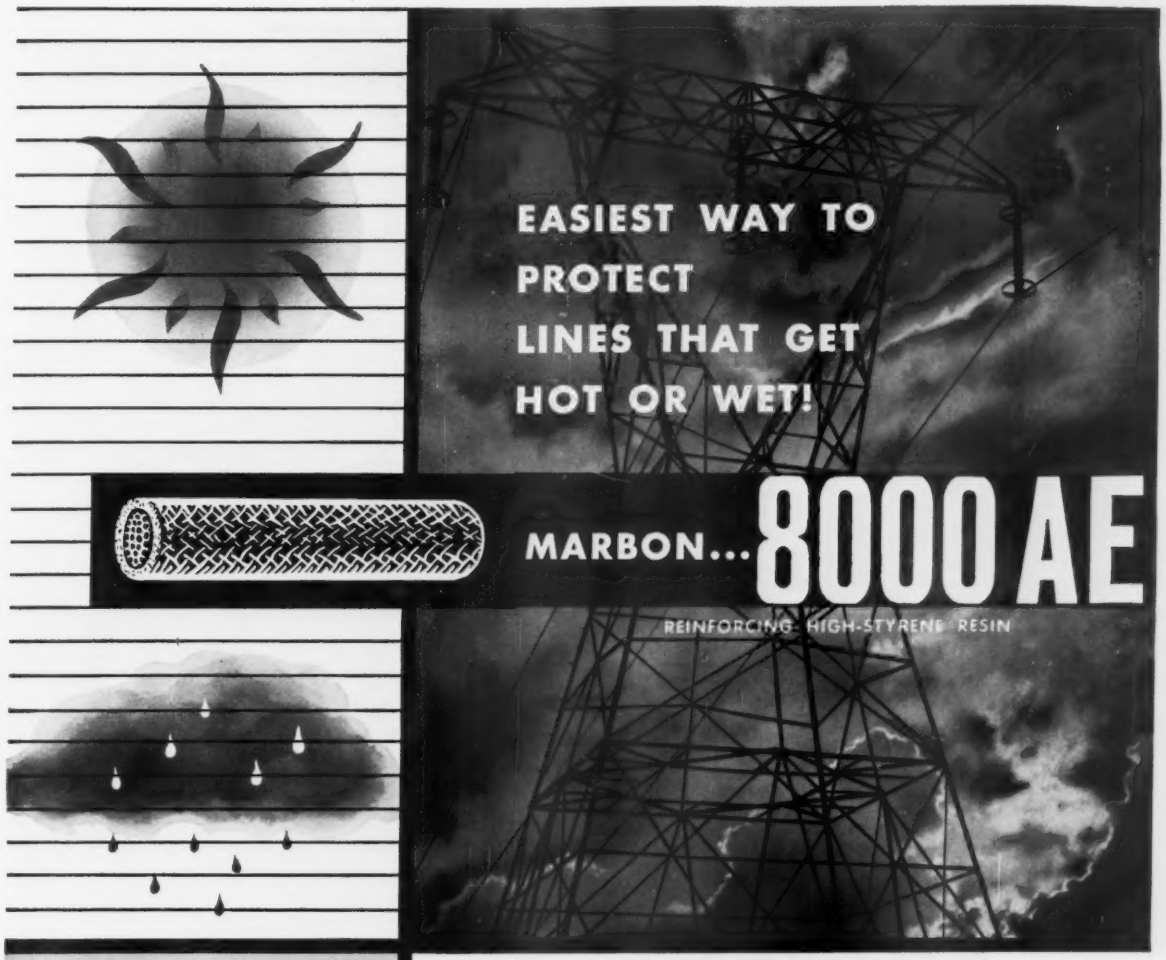
The resulting mixture is dissolved in an aromatic solvent to form a solution suitable for dipping. A form is dipped in the solution at 150 to 170°F., dried to remove the solvent, and cured by heating above 300°F. The polyethylene functions to eliminate blistering.

## V-Belts

U.S. Patent 2,847,865, issued August 19, 1958 to Joseph Rockoff, Dale L. Waugh, and Robert S. Radow, assigned to Dayton Rubber Co., discloses a notched V-belt which is characterized by spaced serrations about its inner surface.




The belt shown in the schematic above consists of a tension section (11) of superimposed layers of rubberized bias-cut textile fabric, a neutral axis section (12) of continuously wound inextensible cord embedded between thin layers of rubber (13 and 14) and a compression section (15) composed of rubber (16) which is loaded with finely ground textile fibers (17) and

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Source of radiation is two Atlas enclosed violet carbon arcs.

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From 21 to 126 samples, depending on size, can be simultaneously exposed to the light of the Atlas Enclosed Carbon Arc. Temperature is controlled automatically and humidity is furnished by evaporation from a constant water reservoir. Operation of the Fade-Ometer is completely automatic, permitting the machine to be left in continuous 24-hour operation.

The Carbon Arc Lamp in the Fade-Ometer produces radiation at the sample similar to sunlight, both as to intensity and spectral distribution.

If your product is subject to deterioration by sunlight our engineers, with over a quarter of a century of experience in predetermining the fading of materials, can help you. *Catalog with technical information on request.*

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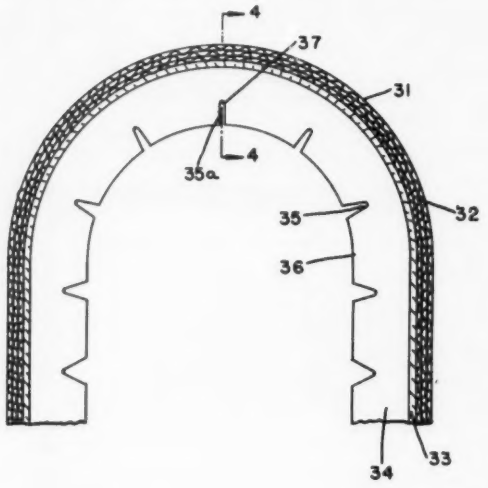
*Manufacturers of accelerated testing equipment for over a quarter of a century.*

# PATENT REVIEW

underlying which is a base strip of rubberized bias-cut fabric (18). As illustrated, the inner surface of the belt is provided with spaced transverse V-shaped serrations (19) which form substantially trapezoidal lugs or transverse ribs (20).

As shown below, when the V-Belt is flexed, the outer layer must be able to absorb tension and




the inner layer compression, in order to prevent tears or cracks from the lines of serration. The structure of the belt provides this. The notching of the belt takes place after the final vulcanization, the removal of the belting material alleviating any internal stresses that have arisen in the belt during the building or vulcanizing stages of manufacture.

### Adhering Butyl Rubber to Fabric

U. S. Patent 2,835,624, issued May 20, 1958, to Edward Cousins and assigned to Goodyear Tire & Rubber Co., relates to a method of effecting a bond between butyl rubber and materials such as regenerated cellulose, nylon, cotton and other fibers, for use in tires.

The objects of this invention are accomplished by applying to yarns, filaments, cords, fabrics or the like a butyl rubber containing an organic isocyanate and an aromatic dinitroso compound or an aromatic dioxime, and bonding the resulting composite structure to butyl rubber by associating the composite structure with unvulcanized butyl rubber, and vulcanizing the same.

Thus, butyl rubber is mixed with an organic isocyanate and an aromatic dinitroso compound or an aromatic dioxime to modify its properties and to improve its adhesiveness to filaments,

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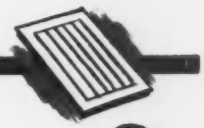

**HEELS AND SOLES ALL TYPES OF SPONGE**

**MOLDED PRODUCTS PACKING**

**AUTOMOTIVE MOLDED PRODUCTS, TIRES AND CAMEL-BACK**

**PRESS ROLLERS WIRE AND CABLE INSULATION**

POLYMEL DX 111 Promotes dispersion of all types of rubber fillers • Aids flexibility • Excellent extrusion • Noted for Flex-crack performance • Good abrasion and tear resistance • Better aging • No coloring property • Low Mooney

**PROPERTIES**

| | |
|---|---|
| Natural State | Powder |
| Color | Amber |
| Specific Gravity | 1.11 |
| Melting Point | Pressure Sensitive |
| Composition | Modified Polystyrene |
| Odor | Characteristic |
| Toxicity | Not Known to be toxic |

**PRICES** (F.O.B. Baltimore)

| | |
|---|---|
| 1 drum to 4900 lbs. | 14¼c lb. |
| 5000 lbs. to truckloads | 13¾c lb. |
| Truckloads | 13¼c lb. |

**FOR EASE OF**

- Handling
- Weighing
- Processing
- Incorporating in batch

MANUFACTURERS OF Compounding ingredients for Reinforcing, Plasticizing, Extending and Processing Natural and Synthetic Elastomers.

Sales Agents Summit Chemical Co., Akron, Ohio

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RED IRON OXIDE colors
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Each is manufactured to rigid specifications for copper and manganese content, pH value, soluble salts, fineness, color, tint and strength by controlled processes and with special equipment.
If you haven't already done so, try these finest of all oxide colors. Our 79 years of experience in the pigment business is your guarantee of absolute uniformity of pigment product.
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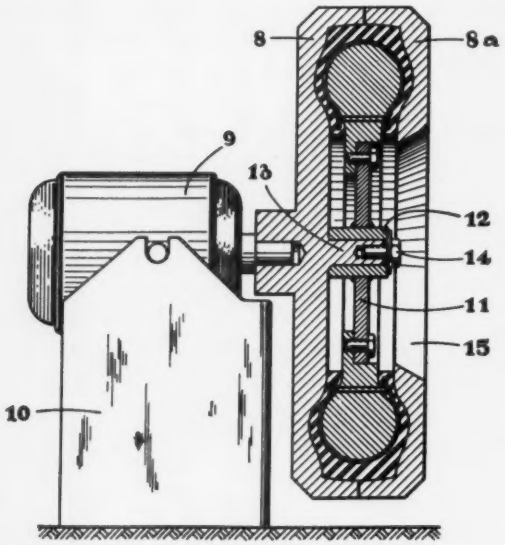
# PATENT REVIEW

fibers, cords, fabrics, and the like. The exact nature of the reactions occurring is not known, but an improvement in adhesiveness is obtained and a decrease in the plastic flow of the rubber results.

### Centrifugal Casting of Tires

U. S. Patent 2,860,379, issued November 18, 1958 to Richard Beckadolph and Walter Niclas, assigned to Continental Gummi-Werke A. G., describes a method of manufacturing tires by centrifugal casting.




The two parts of the mold are designated in the accompanying diagram with the reference numerals 8 and 8a. The arrangement includes a drive motor (9) having the mold (8, 8a) connected to it so as to rotate the mold. The motor (9) is supported by a frame (10). After the inserts and cores have been placed upon the mandrel, the latter is by means of a disc (11) and a bushing (12) placed upon a stud (13) forming a part of the mold section (8).

The mold is rotated while material is filled into the mold through an aperture (15). The quantity of material to be filled into the mold through this aperture must, of course, be sufficient to fill the cavity corresponding to the cross-section of the tire to be produced. The mold is rotated until a solidification of the material has occurred. After solidification, the mold is opened and the disc (11, 12) is removed.

The centrifugal casting method may be followed

*throughout the world*

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The performance-proved magnesium oxide

Want to eliminate scorch damage in neoprene processing? Specify MAGLITE D. Tests prove that it offers better scorch protection for neoprene than any other magnesium oxide you can use. MAGLITE D also helps solve storage problems since it occupies about one-third the warehouse space as many of the lightweight magnesias. The benefits of using MAGLITE K, M, or Y for other elastomers and certain product or process requirements are equally impressive. For samples and technical information write to MERCK & CO., INC., Marine Magnesium Division, Department RA-4, Rahway, New Jersey.

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# PATENT REVIEW

by a short heat treatment which will be beneficial for the polymerization of the usually employed synthetic materials. Finally the tire is removed from its mandrel. In order to facilitate this removal, a collapsible mandrel may be employed.

### Reducing Scrap Rubber

U.S. Patent 2,853,742, issued September 30, 1958 to Paul J. Dasher, assigned to Dasher Rubber & Chemical Co., describes a process for reducing scrap vulcanized rubber to finely divided powders (40-200 mesh) in a Banbury machine.

The action of the bladed rotors on the vulcanized scrap is such as to bring about a high and rapid input of energy, thereby causing the temperature of the mass to rise rapidly. Suitable provision is made to prevent the temperature from reaching the level at which substantial agglomeration of subdivided particles will occur.

### Cross-Linked Copolymer

U.S. Patent 2,847,406, issued August 12, 1958 to Norman R. Legge and assigned to American Synthetic Rubber Corp., concerns the polymers produced by copolymerization of butadiene and styrene in the presence of divinyl benzene as a cross-linking agent.

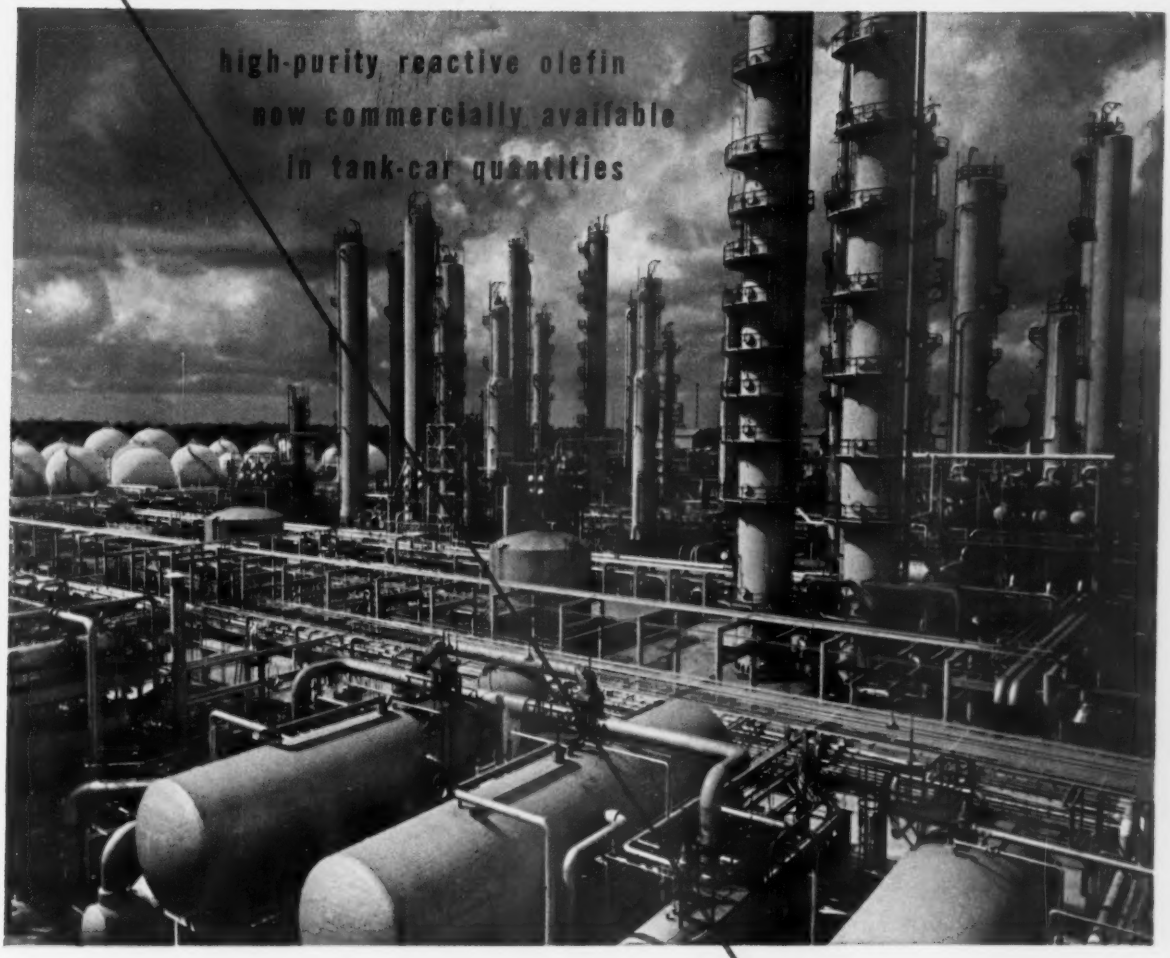
The object of the invention is to improve the tensile strength of cross-linked polymers without corresponding depreciation of their utility as processing aids in calendering or shaping operations. This object is attained by adding the divinyl benzene in increments as the copolymerization proceeds, instead of all at once.

### Other Patents Of Interest

| Subject | Inventor or Assignee | Patent No. | Date |
|---|---|---|---|
| Vented curing bag | Goodyear Tire & | 2,851,729 | 9/16/58 |
| Tire testing apparatus | Bishman Mfg. Co. | 2,852,935 | 9/23/58 |
| Aluminum resinate rubber composition | General Tire & Rubber Co. | 2,854,423 | 9/30/58 |
| Vulcanization of polyurethane elastomers with diisocyanates | E. I. DuPont de Nemours & Co. | 2,858,296 | 10/28/58 |

**Copies of any patents, including those described here, are available from the Commissioner of Patents, Washington 25, D. C., for 25 cents each. Do not send stamps.**

# n-BUTENE-1 (95% minimum)




Substantial commercial production of pure n-Butene-1 at an attractive price should stimulate application research on its many useful reactions.

n-Butene-1 undergoes a wide range of polymerization, copolymerization, hydration, alkylation, oxidation and hydroformylation (oxo process) reactions—many having significant commercial petrochemical possibilities.

We will welcome the opportunity to work with you on the broader uses of n-Butene-1. We also invite inquiries for specifications, price and delivery quotations on

**ISOBUTYLENE** (99 + % pure)
**n-BUTENE-2** (95% minimum)
**BUTADIENE**
**DIISOBUTYLENE**
**TRIISOBUTYLENE**

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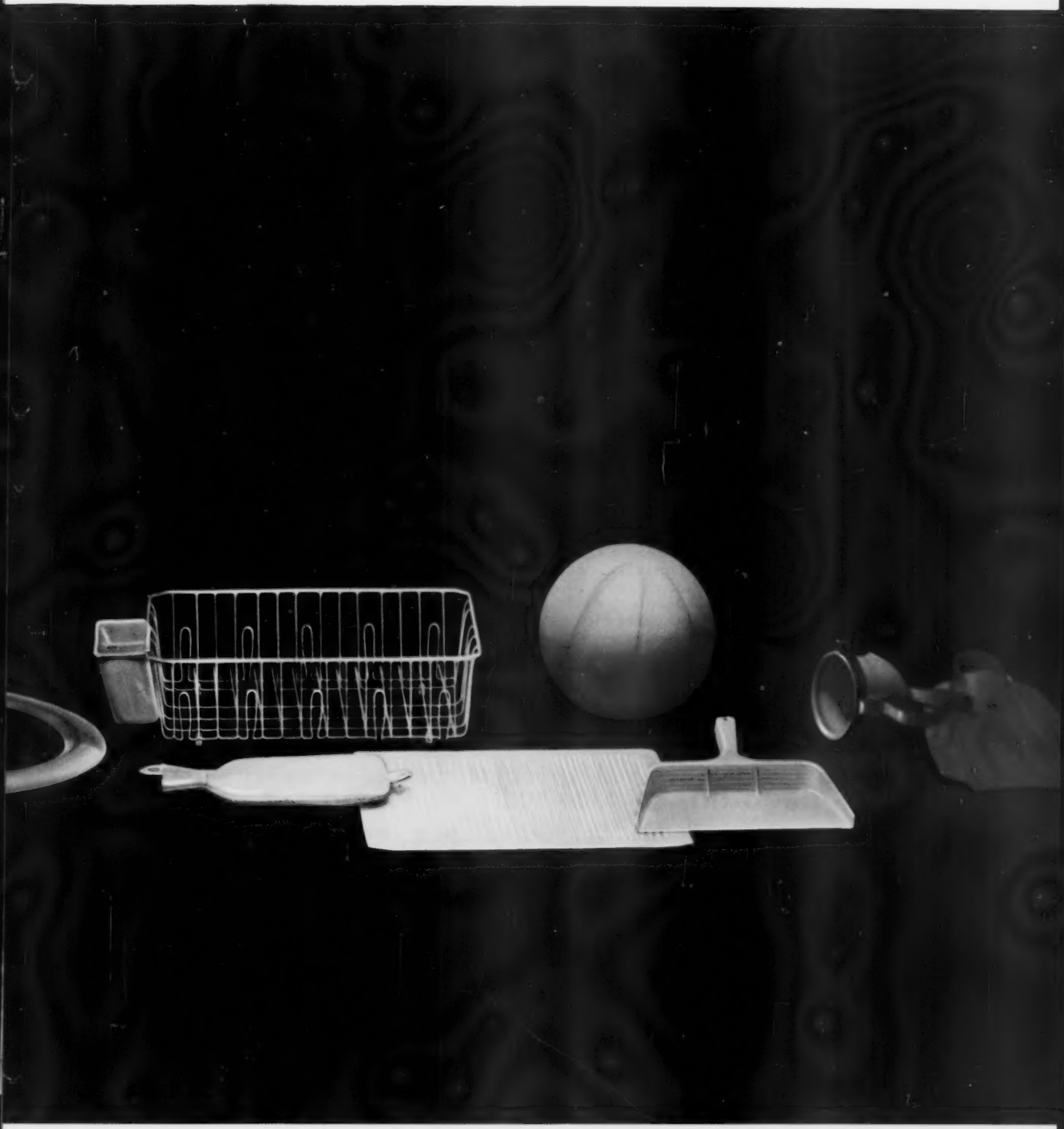

The colors you can build into white stocks reinforced with one of these three high quality Columbia-Southern pigments actually outspan the spectrum. Your products can glow in vivid brights, deep rich tones, subtle pastels.

Hi-Sil, Calcene, and Silene are brightening sales and profit pictures for manufacturers of colored housewares, sports equipment, soling, automotive products, and many other goods. The lesson is clear: color is here to stay—and the more products that color enhances, the better consumers and retailers like it.

Brand identity cued to color might well move your line faster. If you've already switched to color, Hi-Sil, Calcene, or Silene may prove helpful in upgrading specific properties. In addition to making color practical, these unique white reinforcing pigments impart excellent physicals that help products stand up under extreme degrees of punishment. For individual formulation assistance, just address us at Pittsburgh or at any of our fourteen District Sales Offices.

Columbia-Southern Chemical Corporation, One Gateway Center, Pittsburgh 22, Pennsylvania. Offices in principal cities. In Canada: Standard Chemical Limited.

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The "pickle". . . invented in 1820 by the English coach-builder, Thomas Hancock, was the first rubber masticating machine. Hancock gave it the misleading name of "pickle" to confound competitors. His hand-cranked machine ushered in the era of rubber compounding and so tremendously increased the usefulness of rubber.

## You'll need no "pickle" with

# NEW S-1507 RUBBER

A hundred or more years ago a "pickle" was used in the making of good rubber products. But the pickle and modern masticators, too, take valuable time to break down rubber. To eliminate this costly production step, Shell has developed S-1507, a new low Mooney version of popular S-1502.

New S-1507 needs no mechanical viscosity reduction whatever. It comes to you ready for immediate use in chemically blown sponge and other products that demand easy processing and good mold flow.

- A light-colored, non-staining polymer, S-1507 differs from S-1502 in that its viscosity range is 30-38 instead of 46-58.
- S-1507 is recommended for white stocks not only because of its excellent color characteristics but also because the elimination of peptizing agents removes a source of discoloration.
- Physical properties of finished stock containing S-1507 closely compare with those of compounds made with plasticized high Mooney counterparts.

Write or phone for detailed information on S-1507 or other Shell Chemical synthetic rubbers . . . the widest selection available from a single source . . . Torrance, California. Our telephone number in Los Angeles is FAculty 1-2340.

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SHELL

# capitol cues

CREDIT IS GOING TO GET A LOT TIGHTER in the months ahead. Up to now, despite the steady increases in interest rates, money has not been really scarce—that is, really hard to come by. But soon after the middle of the year you'll see a significant change. And before this trend turns around, you may well see the country's tightest credit situation since World War I.

Though the supply of money has been going up since February, the demand for loans has risen even faster. A number of the banks are now "loaned up." As a result, loan interest rates have risen from an average of 4.2% for borrowers of all sizes in February to 4.7% in May. Rates are near a 30-year high.

Here's what will tighten credit in coming months:

- Business investment is now on the rise and will probably be shooting up this Summer. Many firms are increasing their expansion plans. Consumer buying will expand rapidly, too.
- Public works programs of state and local government units will prompt sale of near-record amounts of municipal bonds.
- Credit policies of the Federal Reserve will be tightened to reduce the amounts of money available to banks for lending.
- Treasury financing of deficits will fall on banks as many companies put profits into expansion, not U.S. obligations.

Interest rates probably will go up another ½% before this cycle is over. Many borrowers will discover that lenders are screening more closely. Some will get less than their needs.

SOME RESERVATIONS ABOUT TODAY'S GOOD BUSINESS are now being expressed in Washington by officials and economists. Of course, they are well pleased about the strong upward surge that is under way; but they have some nagging questions as to what may be lying ahead. They are concerned over prospects in some lines that are doing well now, as well as about the credit outlook.

Though inventory building is exceeding forecasts, giving business a rosy hue, much stocking-up reflects fears of a steel strike. New housing starts are at near-record rates, but officials fear a growing shortage of mortgage money will soon begin to slow things down. Auto sales are doing well, but much of recent production has gone to dealers' stocks.

A slower rate of expansion later in the year wouldn't cause pessimism among analysts. It could stretch out the upturn; then current prosperity might extend to late '60, at least.

A NEW TONE IN STOCK MARKET SPECULATION, detected in the past month or two, is worrying officials in Washington. They fear what it can do to the business upturn for it has some of the flavor of 1929. Investors seem to be thinking of buying for a quick profit only, rather than investing for the long haul on the basis of reasonable earnings or a company's dividend prospects. Government agencies are doing what they can—going after those who break market rules, curbing credit, and issuing warnings to the public.

# capitol cues (cont'd)

U.S. EXPORTS WILL INCREASE ABOUT 6% in the second half, according to government foreign-trade experts. This implies another plus for business because the lag in shipments abroad so far this year has been one of the few negative factors in the economic outlook. During the first quarter, exports dropped 6% from 1958's $16¼ billion to an annual rate of about $15¼ billion. In the second half, the experts see the rate getting back up to $16 billion.

One big factor in the exports turnaround will be a pick-up in sales of cotton. (A drop in fiber sales accounted for about half the total export decline of the first quarter.) Now, the Agriculture Department plans to lower the price of cotton in overseas markets to make it more competitive.

Other exports will do better, too—industrial machinery, mining, farm, and construction equipment, semi-finished manufactures, and grains; but these gains will be small. Shipments will rise to Europe, Cuba, and the Far East.

PROTECTIONISM IS ON THE RISE IN THE U.S. these days. Foreign trade experts point to recent actions curbing imports of wool, lead, zinc, and oil. Similar moves may come in electrical equipment, cobalt, dental drills, furs, leather, carpet wools, etc. Tighter curbs on these products are under study.

Here's what's behind the shift away from free trade:

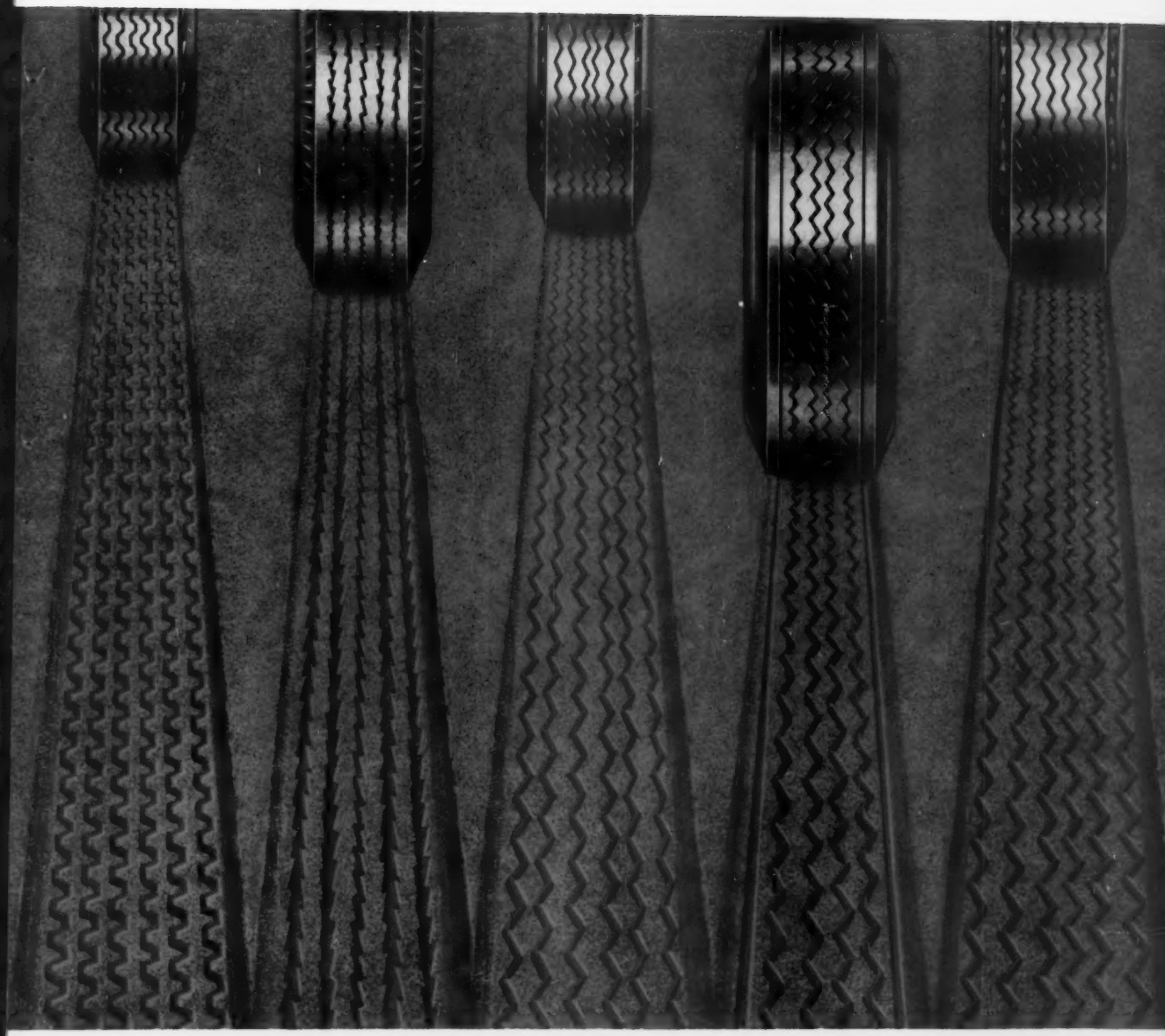
- The unions, which formerly went all out for lower barriers, now are joining with industry in an attempt to save jobs.
- Southerners, once so concerned with foreign sales of cotton, tobacco, etc., now have industries they want to protect.
- The Common Market being set up by Europeans, it is feared, will mean a vastly increased flow of goods to this country.

THERE ARE GOOD OPPORTUNITIES IN MISSILE WORK for small and medium-sized firms, say federal procurement officials. And it's not only rockets, fuels, or very complex electronics that's involved in missile-buying. The various missile agencies also buy a lot of supporting products—abrasives, building materials, lumber, chemicals, paint, plumbing supplies, hardware of all types, drafting materials, etc., etc. The government has set up several programs to help smaller firms get a share of available subcontracts; work is specifically set aside by buying officials for small firms, exclusively.

How should a small business go about getting an order?

- Check your immediate area for prime contractors who can place subcontracts. Chambers of Commerce can give you help on this.
- Check U.S. publications for information on available work. Write the Small Business Administration, the armed services, and the Commerce Department to add your name for notification of bids, detailed specifications, and other pertinent facts.
- Contact regional offices of SBA. The agency has vital data on prime contractors, who to contact, and the products needed.

ADLAI STEVENSON IS STILL VERY MUCH A CONTENDER for the Democratic nomination in 1960. His name refuses to fade from talk of Party leaders. Political experts are struck by this fact over and over. Though Stevenson is a two-time loser, many in Washington still think he is the man to beat.



# New Ameripol Micro-Black promises up to 15% longer tire wear

Automobile tires now have a new lease on life, thanks to Goodrich-Gulf's new high-dispersion masterbatch—Ameripol Micro-Black. Already, many leading brands of tires are made with it.

New Ameripol Micro-Black promises up to 15% longer tread wear in tires. That's because it is reinforced with micron-sized particles of carbon black thoroughly dispersed in the rubber by an exclusive process—high liquid shear agitation at the latex stage. Result? Tires and other products made with Micro-Black have controlled uniformity, superior dispersion, greater abrasion resistance.

But that's not all. When you use Micro-Black, you eliminate the weighing, milling, storage and mess of carbon black because it is already integral with the masterbatch. Because Micro-Black is shipped bareback, you also eliminate bag stripping and disposal costs. What's more, you can choose from *nine* high-dispersion types of Micro-Black.

With plants at Port Neches, Texas, and Institute, West Virginia, Goodrich-Gulf has the world's largest production capacity for synthetic rubber. For information on Ameripol Micro-Black, write for new illustrated Micro-Black data book, just off the press.

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AUTOMATION
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*IMPROVE QUALITY CONTROL*
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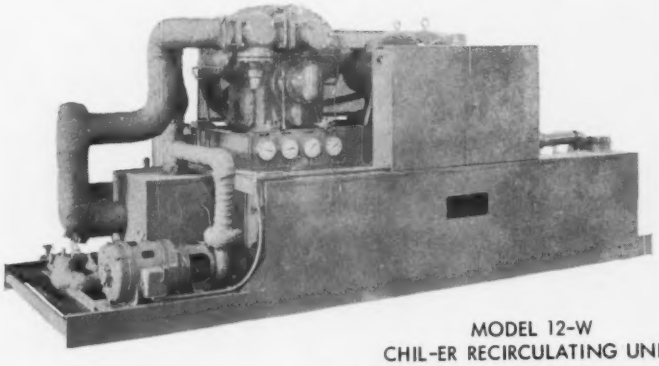

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Chil-er Recirculating Units are designed for use on heavy duty production machines and processes where dependable operation and constant uniform temperature control produces increased productivity of present equipment.

In addition to the increased productivity, operational savings are affected through decreased scorching, reduction of defects and the elimination of slow-down and shut-down due to excessive heat.

Unit operation is automatic. Turn starting switch to ON and automatic controls take over. They not only maintain constant temperature, but also adjust automatically to changing load conditions without manual attention.

Unit selection is based on plant requirements with performance guaranteed.

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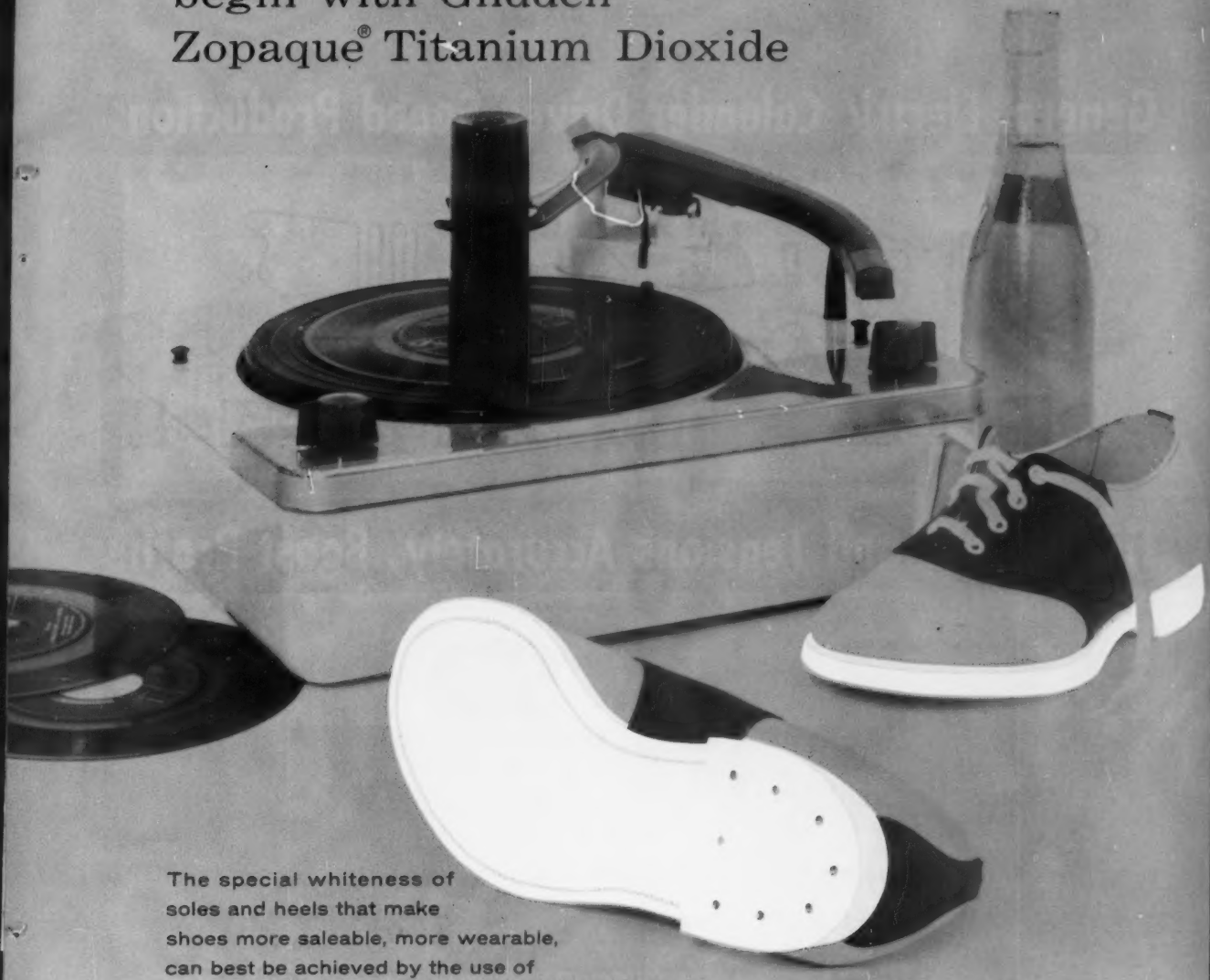

The special whiteness of soles and heels that make shoes more saleable, more wearable, can best be achieved by the use of Glidden Zopaque Titanium Dioxide. The outstanding optical and physical properties of Zopaque make it ideal for white rubber compounding. It imparts maximum opacity and high hiding power; assures maximum resistance to sunlight and weather.

Write now for complete information about Glidden Zopaque Titanium Dioxide, and how it can help you produce finer white rubber products.

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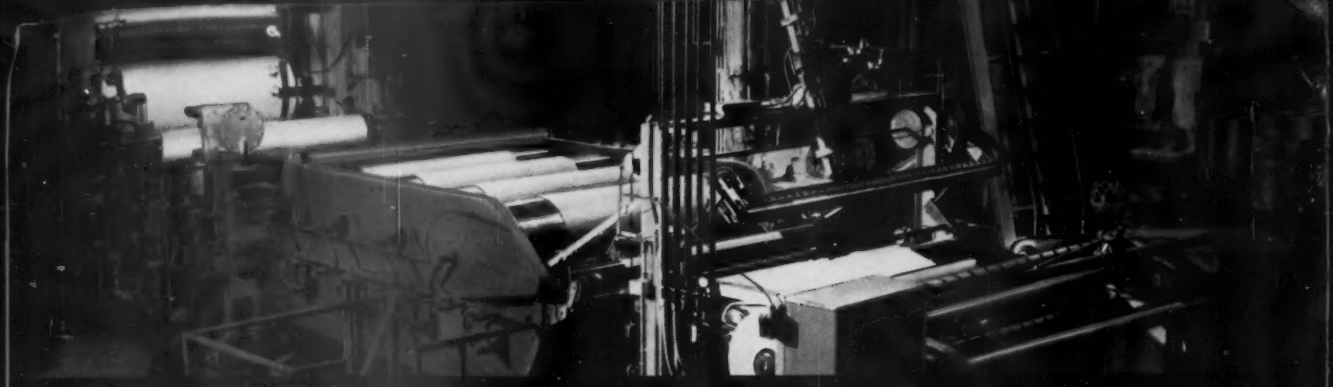
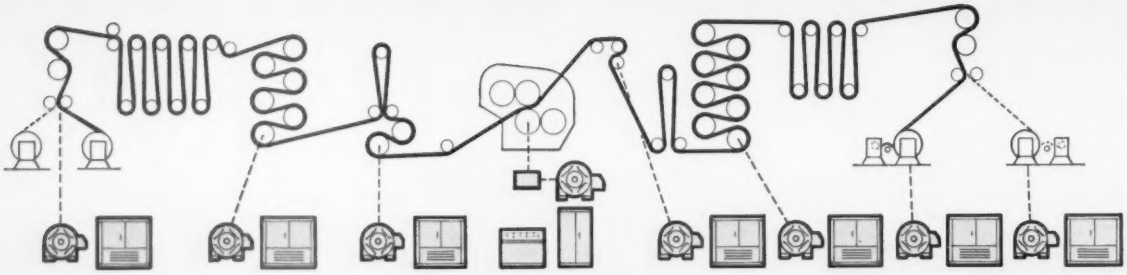
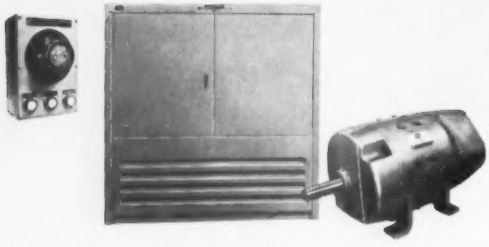


# General Electric Calender Drives Speed Production,



# Hold Gages and Tensions Accurately, Boost Profits



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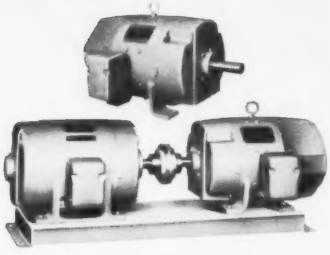

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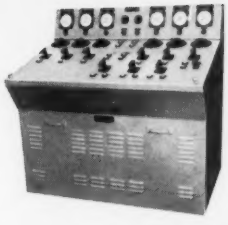

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***General Electric adjustable-speed drives are keys to modernization . . . provide these modern, profit making advantages . . .***

- **Closer regulation** for precise control of gage and tension.
- **Wider speed range** available up to 10:1 or more if required.
- **Controlled acceleration/deceleration** with smooth adjustment to preset speeds prevents jerking, wrinkling, tearing.
- **Lower power costs** result from improved drive efficiencies.

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**is pleased to present**

**its organization of**

# TECHNICAL FIELD REPRESENTATIVES

Convinced that the term "Technical Field Representative" should not be merely a catchphrase for "salesman", Texas-U.S. has devoted a considerable amount of time and effort to the formation of its field organization. These men have been selected for their selling abilities, of course. But more important, they were chosen for their technical abilities to discuss your own operations and applications intelligently, to be truly "representative" of the Texas-U.S. Chemical Company and its philosophy of service.

TEXUS

All members of the Texas-U. S. field organization are thoroughly experienced in the products and problems of the rubber industry. Their extensive industry background, coupled with an intimate knowledge of the uses and advantages of the complete line of SYNPOL butadiene-styrene rubbers, places them in an excellent position to be of service to you.

We are confident that you will find these men the kind of people you will enjoy getting to know, not only as representatives of a leading synthetic rubber supplier, but as sound, technically oriented businessmen with a sincere interest in the welfare of your own operations.

**William J. Burke**
*Director of Sales*

A former Assistant Division Manager in charge of Industrial Sales for the Minneapolis Division of the Texas Company, Bill joined TEXUS in 1957. He has been directing all sales activities for the company since that time.

He is a member of SAE, ASLE and the New York Rubber Group and Rubber Division of the American Chemical Society. Born in Chicago, where he attended Loyola University, Mr. Burke has completed graduate work in the Engineering Departments of the Illinois Institute of Technology and North Carolina State College. During World War II, he served as an engineering officer on a Navy combat vessel. Proud father of six, he welcomes a game of golf for relaxation.

**Arnold Rodde**
*Field Sales Manager*

Arnold's business career, after Bethany College and graduate work at the University of Kansas, has progressed from Lab Supervisor at the Pennsylvania Ordnance Works, to Chief Quality Control Chemist and later Technical Superintendent at the Rubber Reserve plant at Naugatuck, to Manager of the Government Tire Testing Fleet, to Assistant Manager of Rubber Chemical Sales and then Manager of Polyurethane Operations at Naugatuck Chemical.

This background for his present position allows him to be properly classified as an "experienced rubber technologist".

Born in Kansas, Arnold is married, has three children, likes gardening and "all kinds of music". He's a golfer, too ..."a poor one".

**G. B. Wellburn**
*Manager, Special Sales*

"Bick" Wellburn's seventeen years of synthetic rubber experience began with Blaw-Knox and its Government contract for the design of the standard Government synthetic rubber plants. Later, with U. S. Rubber, he served on the original Government committee which developed the standard synthetic rubber plant operating manual.

Production Superintendent for the SYNPOL plant at Port Neches before entering the TEXUS sales department, "Bick" Wellburn received his degree in chemistry from the Philadelphia College of Pharmacy and Science in 1938. He is a member of the American Chemical Society. Living in Westport, Connecticut, with his wife and daughter, "Bick" is an ardent week-end golfer.

**William C. Gwynn, Jr.**
*Atlantic District*

Rubber compounder, analytical and physical tester, technical synthetic rubber salesman for a number of large rubber companies in positions both here and abroad, Bill Gwynn brings a wealth of experience with him to TEXUS' Atlantic District.

In 1940, he entered the Army as a private and six years later emerged a captain. A cum laude graduate of Georgetown College, he attended Georgetown Medical and later studied rubber technology at Akron University. He is a member of the American Chemical Society and its Rubber Division.

Bill's outside interests include golf, tennis and horseback riding. He is married, has three children and lives in Bucks County, Pennsylvania.

**Roger B. Pfau**
*Central District*

No newcomer to the rubber industry, Roger Pfau has been associated with it for the past eighteen years – in both engineering and product purchasing. Since 1950, he has been a technical sales representative for rubber chemicals in the South and Central states. He was active in the formation of, and served as the first Secretary of the Southern Rubber Group.

Roger was born in Chicago, where he attended college. He is now living in Memphis with his wife and three children.

In addition to rubber (which he assures us is his prime interest), you can talk to him about hunting, fishing, swimming, golf, gardening and woodworking.

**John W. Perloff**
*New England District*

In his twenty-two years of broad industrial experience, John Perloff has amassed a great working knowledge in research production, process development, technical service, sales development and sales management. His rubber and plastics experience dates back to 1943 and ranges from process engineer to sales manager.

Graduated from the University of Florida with a degree in chemical engineering, he is a member of the American Institute of Chemical Engineers, ACS, Commercial Chemical Development Association and the Boston and Rhode Island Rubber Groups. Married, with two children, Jack is an amateur golf and tennis enthusiast with ability that borders on the professional.

**Rexford E. Draman**
*Ohio Valley District*

Sales representative for a major rubber company since 1952, Rex Draman's technical experience began in 1941, manufacturing and developing resins for DuPont. He is a graduate of Simpson College in Iowa where he majored in chemistry and also played football. He obtained a teaching fellowship at Iowa State and there completed a year of graduate work in physical chemistry. While working for DuPont, he continued his graduate work at Northwestern, specializing in organic polymerization. He later joined the Rubber Reserve where he obtained several patents on synthetic rubber manufacturing and processing.

Mr. Draman enjoys woodworking; is married and has four children.

**Charles K. Murray**
*Supervisor of Export Sales*

Heading the world-wide team of TEXUS agents and distributors, Charles Murray developed a wide and penetrating knowledge of the export side of the chemical industry while working with British and Canadian companies.

Widely traveled in war (as an infantry and staff officer) and peace (as an export manager), he is an accomplished linguist. He majored in economics at London University and has done important work as a chemical market researcher.

While no sleight of hand attends his sales efforts, "Charlie" is an ardent prestidigitator and member of the Society of American Magicians; is in constant demand as an entertainer. He is married and lives in Hartsdale, New York.

**D. J. Hill**
*Manager of Supply & Distribution*

Responsible for seeing that the right SYNPOLS are at the right place, at the right time, Jack Hill has been Control Manager at the Port Neches Plant since 1950.

A graduate of Indiana University, he began his association with the rubber industry in 1934 with U. S. Rubber. By 1942, he was appointed chief accountant at the Indianapolis Plant. In 1944, he took over as chief accountant of the Government-owned synthetic rubber plant at Institute, West Virginia, and later served in the same capacity at Borger, Texas.

He lives with his family of three, wife, boy and girl, in Beaumont, Texas, and spends whatever leisure time he can find at golf.

**The C. P. Hall Co. of California**
*West Coast Sales Agent*

More than 30 years of rubber sales and service are behind The C. P. Hall Co., TEXUS' agent for the entire West Coast. And nearly as much collective experience is held by the staff of three assigned to TEXUS.

*A. H. Federico*, Vice President (left), is extremely active in industry affairs Immediate past chairman of The Los Angeles Group, he received his science degree at Albion College, Michigan.

*J. T. Modawell*, Sales Manager (top), studied rubber technology at USC, and is presently committee chairman of The Los Angeles Rubber Group.

*C. E. Lake* (bottom) holds a degree in chemical engineering from USC and has completed the courses in rubber technology of the TLARGI Foundation.

**New England District** 2311 John Hancock Bldg., Boston 16, Massachusetts. HAncock 6-5737
**Atlantic District** Colonial Building, 101 East Lancaster Ave., Wayne, Pennsylvania. MUrray 8-7764
**Ohio Valley District** 104 East Market Street, Orrville, Ohio. MUrray 2-4891
**Central District** 786 Madison Avenue, Memphis 3, Tennessee. JAckson 7-1876
**West Coast** The C. P. Hall Co. of California, 1340 East Sixth Street, Los Angeles 21, Cal. MAdison 2-2022

Chances are the new TEXUS Representative serving your district has already called upon you. In the event he has not yet introduced himself to you, please feel free to call upon him for whatever service or information you may require. Or write the address below.

With the establishment of this new field organization, TEXUS renews to you its pledge to provide you with the finest SBR rubbers and technical service and the most prompt delivery available anywhere.

TEXUS

**TEXAS-U. S. CHEMICAL COMPANY**
**260 Madison Avenue, New York 16, N. Y. • MUrray Hill 9-3322**
Executive Offices and Plants: Port Neches, Tex. • TEXUS Research Center: Parsippany, N. J.

# As Soule Sees It...

by Kenneth J. Soule

## Hazards of Thin Plastic Film

Widespread publicity, in newspapers, magazines, on TV and the radio, has been given recently to the tragic deaths of a number of young children due to suffocation. In each case the suffocation was caused when the victims innocently pulled empty thin-gauge polyethylene bags over their heads and were unable to remove the tightly adhering film before the air was exhausted and smothering resulted. In a few cases, a minor variation occurred when infants suffocated in their cribs as the light gauge plastic coverings on the mattresses worked loose and clung tightly to the babies' faces.

As of this writing, about forty children have lost their lives through this type of accident and the National Safety Council has predicted that the number of such deaths will rise to 100 before the end of the year. Under these circumstances, it is not surprising that the situation has been viewed with considerable alarm and that a number of suggestions have been made for reducing or eliminating the hazard. Some of these have been ill-advised and rather nonsensical, such as those which would prohibit the manufacture of the film, or would ban its shipment across state lines or its use by laundries and dry cleaners.

While there obviously seems to be no doubt that the misuse of the film presents a potential hazard to young children, it also appears quite clear that the remedy lies not in forbidding the use of the material, but in educating the adult public as to the dangers involved and what to do about them. In this respect, the situation is no different than as regards medicines, household poisons, and matches. All are extremely dangerous when misused (especially by small children) but we hear no outcry that the manufacture or sale of any or all of them be forbidden by law.

The Society of the Plastics Industry, which is a trade association representing over a thousand firms in the plastic business, has acted promptly and, it seems to me, wisely in this matter. It has launched a nationwide educational campaign to publicize the danger. This will cost at least several hundred thousand dollars in 1959 and will take the form of pamphlets to be widely distributed by state and local health agencies, laundries, dry cleaners etc., as well as numerous full-page warnings in daily newspapers.

Warning labels will also be stenciled on, or attached to the bags containing the laundry or dry cleaned material. In addition, the Society has requested that the television and radio industry continue their extensive coverage of the dangers involved, and warn adults to keep the bags or the film away from children.

It is sincerely hoped that the sum total of all these efforts will succeed in reducing further film deaths to the zero level. However, it must be remembered that no light plastic film or bag ever comes into any home without some adult knowing of its existence. If the adult considers the continued presence of the plastic in the home a potential hazard, he (or she) should promptly get rid of it. Otherwise it is his responsibility to see that it is kept out of the reach of any and all children.

## High-Hat Nylon

Although at this writing, it is only in the suggestion stage, the idea has been advanced that nylon fur might be a worthy successor to bearskin on the regimental hats worn by the guards at Buckingham Palace. It seems that the splendid and imposing looking fur hats which make up the crowning feature of the Guards regalia have begun to show the ravages of time, and in fact, have been criticized as being somewhat moth-eaten.

Since a total of about 1500 new hats would be required for a complete replacement job, the problem of securing that number of top-quality bearskins, suitable for task involved is far from simple. Obviously, they cannot be secured in the British Isles, so the city of Timmons in the Province of Ontario has volunteered to schedule a series of week-end bear hunts in an attempt to provide the needed hides. How successful these safaris will be, remains to be seen.

In the interim, the British Ministry of Supply is investigating the synthetic nylon fur angle, so that the Brigade of Guards may not be left hatless in case the Canadian bears prove to be either too few or too elusive. While the entire matter hardly seems to be of earth-shaking importance, it is still as true in England as in this country that the opposition party often manages to blow issues up out of all proportion to their real import.

Since the Laborites have raised the question in the House of Commons as to what is being done to refurbish the traditional hats or to supply new headgear, it is fairly certain that action will ultimately be forthcoming. The results may not satisfy all of the "royal opposition," but as long as the red-coated Guards maintain their splendid and spectacular costumes, particularly the towering shakos, no one except perhaps the Ontario bears, is going to worry too much as to whether or not the fur used is natural or artificial.

## Lost Wax

It seems to be almost axiomatic that the inclusion of the word "lost" in a phrase, a title, or a description immediately arouses interest, speculation, and sometimes sympathy. Perhaps this is so because the emotions are often involved, such as when a person, a ship or a valuable object disappears and is presumed lost. Or when your favorite baseball team has a dismal record in the Won and Lost records. Or the title, "Lost Horizon," sets you to dreaming of strange and distant places.

Be that as it may, the Lost Wax (or *Cire Perdue*) process of making bronze or other metal castings is a very special case in point. It probably had its origin

# As Soule Sees It (Cont'd)

in prehistoric times, although it did not come into widespread or spectacular use until the 16th century. During that Renaissance era, its chief exponent was Benvenuto Cellini who employed this method to produce many famous bronze statues, including the "Nymph of Fountainbleau," and the heroic "Perseus."

In the Lost Wax process, the term "lost" is perhaps a little misleading. As we shall see, the operators employing the method knew perfectly well where the wax was at all times. As far as they were concerned the wax was specified, served a vital purpose, and then was eliminated. There is, of course, some possibility that to the uninitiated, or to the innocent bystander what happened to the wax was a mystery and to such people, the wax truly was lost.

The casting of statues or art objects from bronze is a rather complicated process, and is subject to many possible variations in procedure. One of these variables involves the use of wax, as in the Lost Wax method, and in this process, unvulcanized rubber may or may not be an important part of the equipment used, depending on the particular technique being employed. To illustrate, if the model has been produced by the sculptor in wax, no rubber or other flexible mold material is involved. The wax model is merely covered or invested, with one or more semi-liquid coatings which rapidly set to a rigid state.

When the "investment" is hard and firm, the entire assembly is heated to around 1200°F. During this operation the wax softens and ultimately volatilizes completely, escaping through previously prepared sprues and gates. Thus, the wax becomes "lost" and a solid mold remains which is a negative image of the original wax sculpture. To produce the bronze object desired, molten bronze is then poured into the mold to fill the entire area, or the mold may be placed in a centrifugal casting machine which sends a reduced quantity of molten metal out against the mold-producing a shell casting.

On the other hand, if the sculptor has furnished his model in plaster or clay, the next step may involve the use of sheets of specially compounded unvulcanized rubber. From these a cocoon is built around the model, and after careful wrapping and vulcanization, we have a sturdy flexible rubber mold which is then cut open along pre-determined lines and stripped from the core. From this reverse (or negative image) mold, it is possible to produce a wax model which exactly duplicates the sculptor's original creation. From here on, the *modus operandi* for producing the finished bronze object follows the procedure outlined above.

Each of the two general methods described has its advantages and its exponents, depending both on the medium with which a given sculptor prefers to work, and also the desirability of a flexible mold (rubber) versus a rigid investment. Since both methods involve the Lost Wax process it might be well to point out that one of the chief merits of this medium lies in the fact that castings so produced are almost perfect as they come from the mold requiring little or no machining, chiseling or finishing. This is not true with other types of bronze casting.

One final note, we read that the Massachusetts Institute of Technology, under a $10,000 Rockefeller Foundation grant, has hired a Boston sculptor to work with its present metallurgy staff to study new methods of casting art objects in metal. Presumably the Lost Wax process will also come in for its share of consideration.

For many years, a great variety of small metal parts used by artists, dental technicians, jewelry manufacturers, industrial designers etc. have been centrifugally cast in soft rubber molds. As the durability and the heat resistance of such rubbers have been improved, the areas of their adaptability and the size of the satisfactory castings produced has greatly increased. We feel certain the peak in performance has not yet been achieved and therefore sincerely hope that the merits and unique usefulness of such specialized rubber compounds, in these various operations, will also be included in the scope of this comprehensive investigation.

### Fore!

Many different types, sizes, and varieties of flying saucers have been reported all over the world during the past fifteen or twenty years. Probably the bulk of these celestial visitors have turned out to be ordinary objects viewed under unusual conditions.

One of the most peculiar of these occurrences took place in a Mid-western town a few years ago. A highly agitated citizen called up the police late one evening to report that a flying saucer was sailing around his backyard, spitting sparks and shooting flames. The skeptical gendarmes investigated and sure enough the show was taking place as advertised. After a short but spirited chase they succeeded in capturing the go-devil. To their great surprise, as well as that of their informant, the culprit was found to be a golf ball.

Apparently one of the neighbors had been burning leaves or other debris in his garden, and in the accumulation was an old golf ball. When the trash was burned the ball also caught fire and as its tightly wound rubber thread suddenly and continuously gave up its pent-up energy, the golf ball shot and darted like an erratic rocket.

If any reader plans to try out this pyrotechnical experiment, it is suggested that a solo test should be made before introducing a demonstration at an evening corn roast or other neighborhood cook-out.

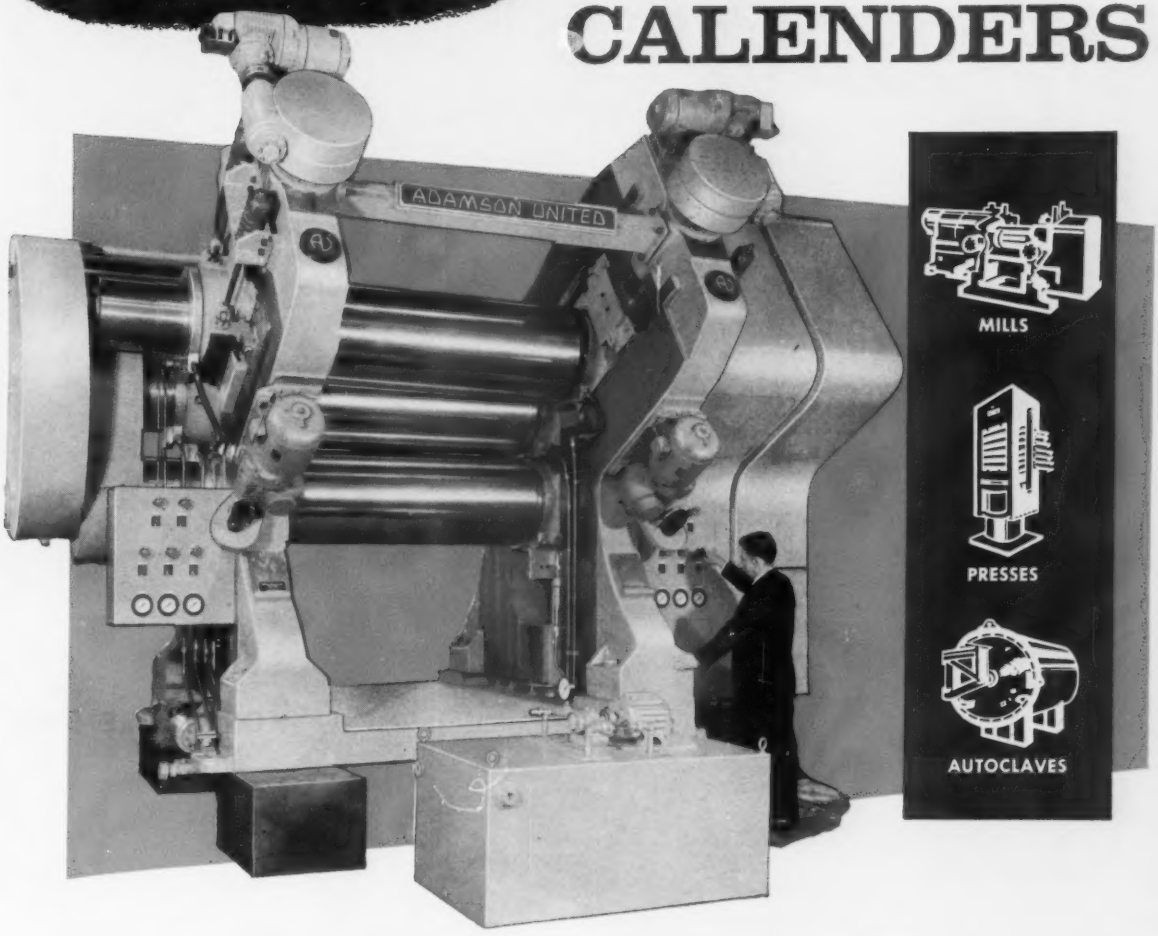
A word of warning is also very much in order regarding the possible hazard involved because of the liquid centers sometimes used in certain brands of golf balls. If such a ball were heated in a bon-fire the boiling liquid could easily become a deadly weapon. If you must try any experiments along these lines with old or new golf balls, be very careful, and above all, use only balls with a solid center!

### Culinary Note

A recent C and E N flash reports rumors of a merger of one of the large pump companies and a major nickel producer. Proposed product: Pumpernickel . . .

ADAMSON UNITED

# PRECISION CALENDERS




Whether the project calls for supplying all mills, calenders, presses and associated machinery for a completely new and modern rubber or plastics plant, or a single unit for a new process, you'll find Adamson United equipment offers the most efficient design and up-to-date operating features for today's production requirements. Our full line of modern rubber and plastics calendering equipment is an outstanding example.

Adamson calenders are skillfully engineered for production of close tolerance, high quality material at high speed. Standard sizes range from 8" x 16" laboratory models to large production units with rolls measuring 36" x 92". Various types include 2, 3 and 4 rolls; vertical, 120 degree, inverted-L, Z-type, cascade, inclined and others. The unit illustrated is a 3-roll, 120-degree, connecting gear-type calender equipped with roll crossing. Adamson calenders are also available with such precision operating features as roll bending, zero clearance, flood lubrication, drilled rolls, anti-friction bearings and pinion-stand drive.

With a complete line of accessory equipment for continuous processing, Adamson United is prepared to handle any rubber or plastics calendering problem you may have. Our engineering staff is at your service — to recommend the unit best suited to your needs, or to develop special equipment to meet your specific requirements. Write or call for complete details — without obligation.

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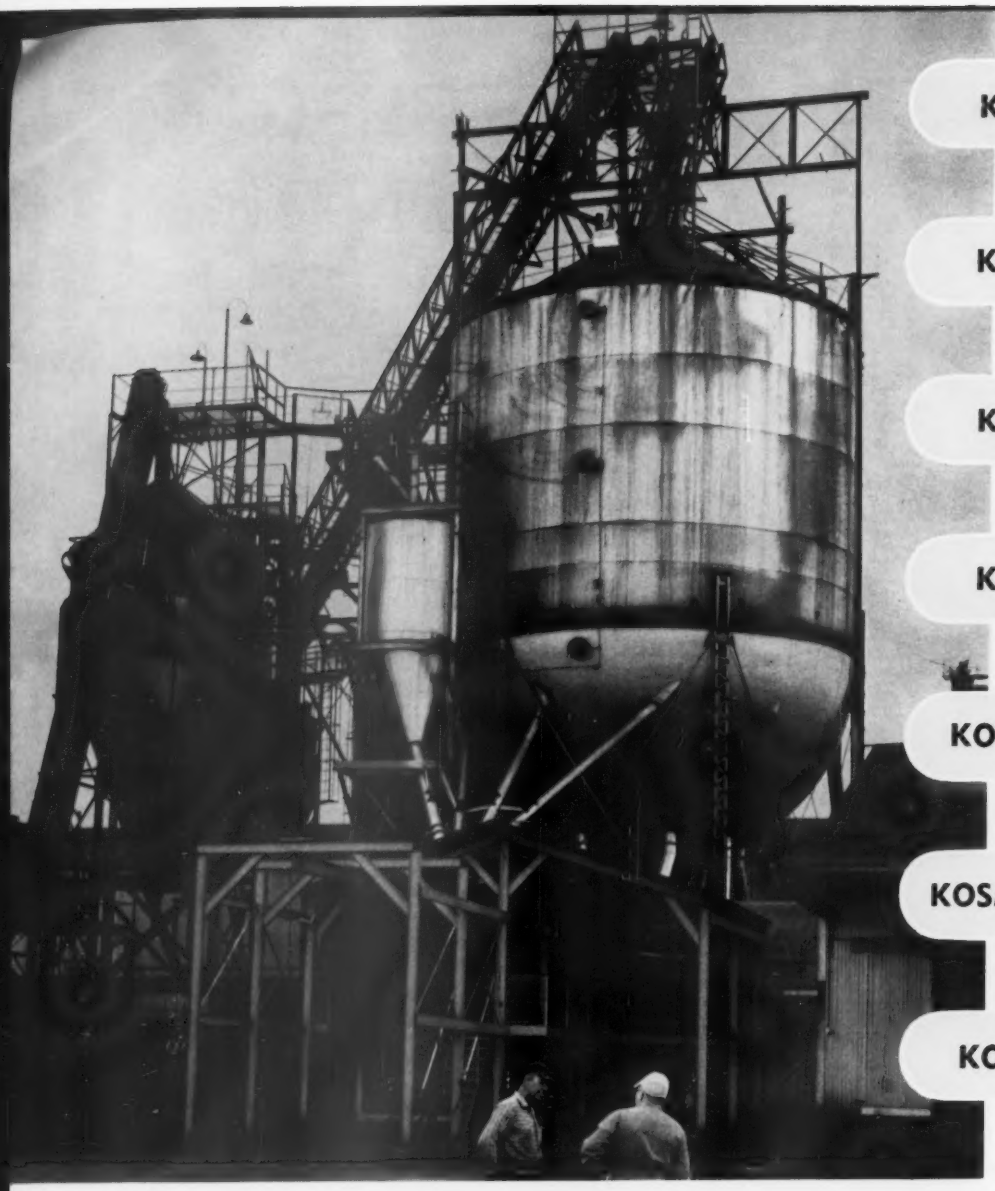

KOSMOS 50

KOSMOS 60

KOSMOS 70

KOSMOS 85

KOSMOBILE 77

KOSMOBILE S-66

KOSMOBILE S

# ARANSAS PASS...
# CARBON BLACK COMPLEX

United Carbon's Aransas Pass carbon black plant, near Corpus Christi, Texas, is a versatile production complex.

A pioneer facility for the making of furnace blacks, it also produces rubber grade channel blacks and special color blacks for the ink, paint and other industries.

The men who operate the Aransas Pass plant work with two concerns in mind: maintaining highest quality and the highest degree of uniformity.

And — you can count on this when you specify KOSMOS carbon blacks — they're doing an excellent job of it!

UNITED CARBON BLACKS

*Carbon Blacks of Excellence*

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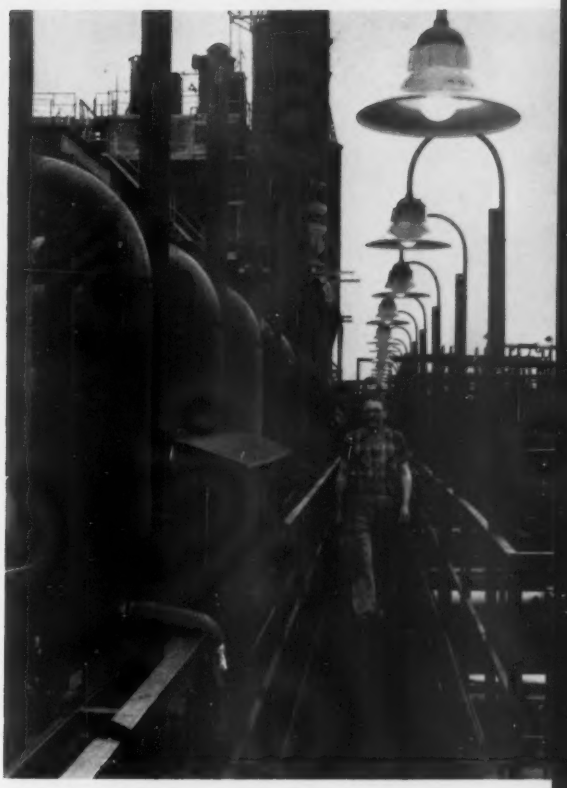

**CONSTANT ATTENTION and careful checking go into the making of United Carbon Blacks here.**

From Aransas Pass — KOSMOS 70 ISAF for tough, maximum mileage tires; KOSMOS 60 HAF, offering highest reinforcement and outstanding resistance to cuts and cracks; KOSMOS 50 FEF for smooth, fast extrusions; KOSMOS 85 SAF for the ultimate in abrasion resistance

And from the Aransas channel units — KOSMOBILE 77 EPC, KOSMOBILE S-66 MPC and KOSMOBILE S HPC, in wide demand for years for their good reinforcement qualities and the tensile strength they impart. Other blacks for inks, paints, paper, etc., also are made here.

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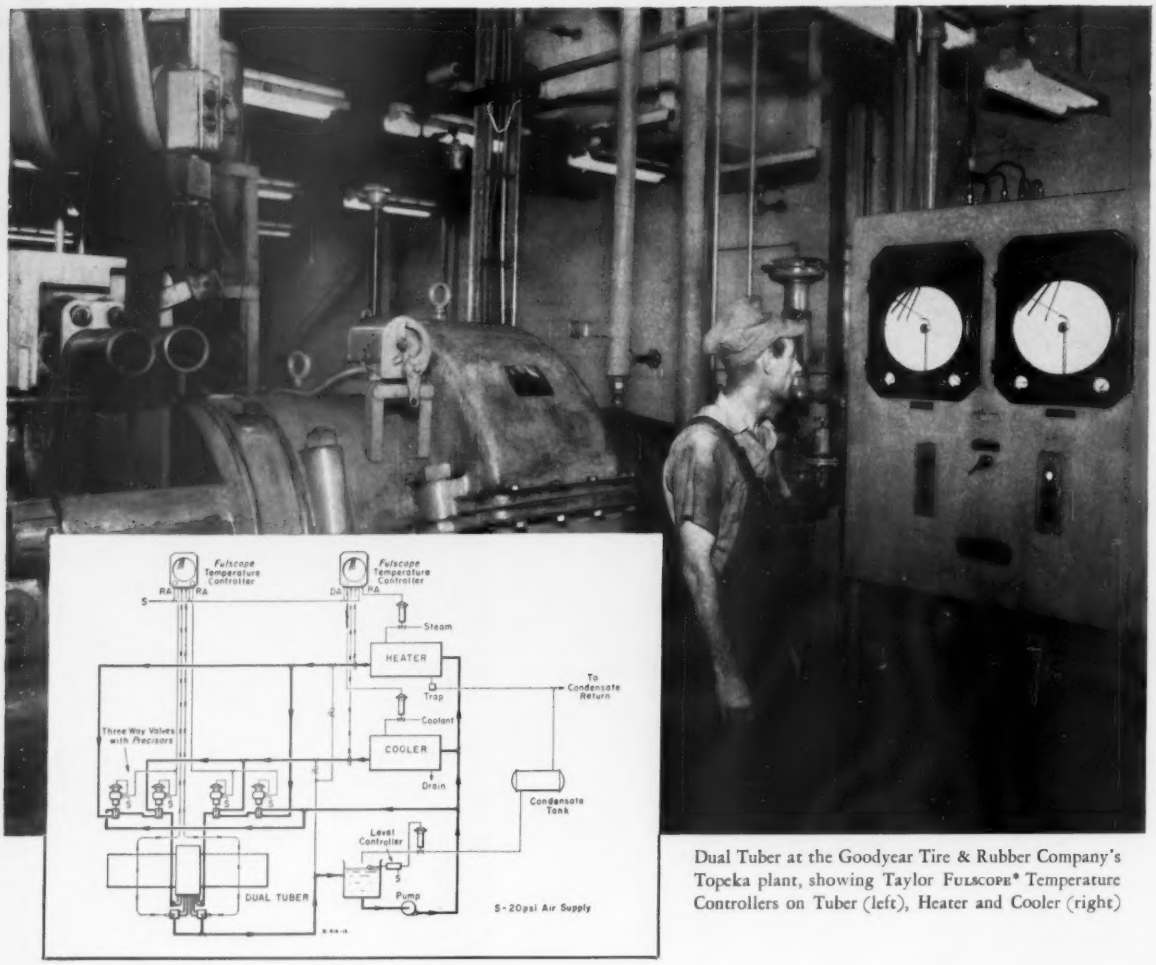



Dual Tuber at the Goodyear Tire & Rubber Company's Topeka plant, showing Taylor Fulscope* Temperature Controllers on Tuber (left), Heater and Cooler (right)

# GOODYEAR CHOSE *Taylor*

***Dual Tuber control system insures a perfectly uniform product regardless of load changes***

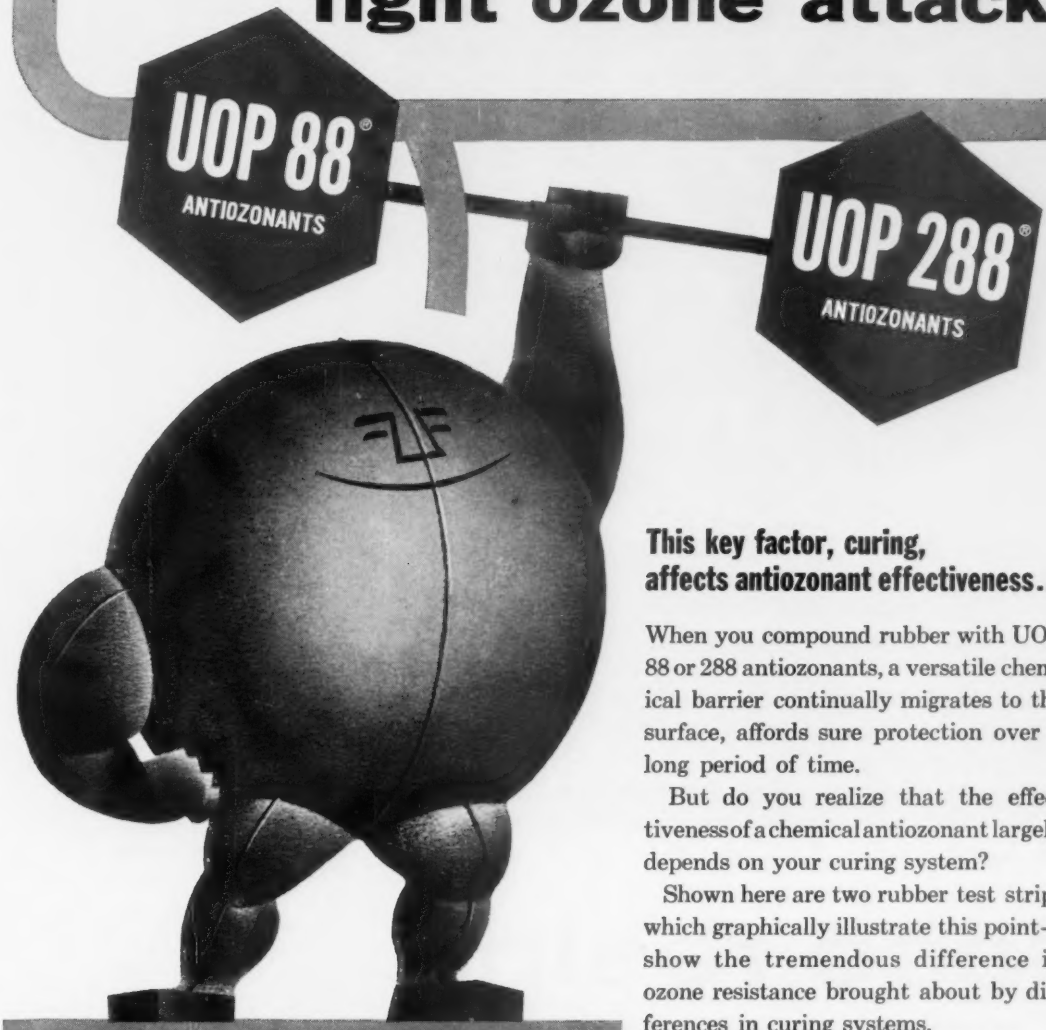
Of the many methods tried for controlling extruder temperatures, this Taylor system has been proved most satisfactory. It involves circulating a constant volume of liquid at exactly controlled temperatures.

For well over a year it has performed with a high degree of accuracy. Whether you're producing tires or mechanical goods, a Taylor control system will help to maintain uniform quality, reduce operating costs and eliminate the hazards of manual operation. Call your Taylor Field Engineer, or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Ontario.

*Reg. U.S. Pat. Off.

*Taylor Instruments* **MEAN ACCURACY FIRST**

# how does your CURING SYSTEM help fight ozone attack?




**This key factor, curing, affects antiozonant effectiveness...**

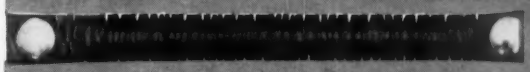
When you compound rubber with UOP 88 or 288 antiozonants, a versatile chemical barrier continually migrates to the surface, affords sure protection over a long period of time.

But do you realize that the effectiveness of a chemical antiozonant largely depends on your curing system?

Shown here are two rubber test strips which graphically illustrate this point—show the tremendous difference in ozone resistance brought about by differences in curing systems.

UOP facilities and technical personnel are available to help you achieve maximum effectiveness in the use of antiozonants. Just write or telephone our Products Department.

**The SBR specimens below were exposed to ozone at 100° F with 20 percent elongation for 52 hr. at 33 pphm ozone, then 187 hr. at 63 pphm ozone.**



Carbon black—HAF (high abrasion furnace), Curing system—4 phr tetramethylthiuram disulfide; Hours to first crack—7 to 23.

Carbon black—HAF (high abrasion furnace), Curing system—2 phr sulfur, 1 phr N-cyclohexyl-2-benzothiazole sulfenamide, No cracks in 239 hr.

UOP

UNIVERSAL OIL PRODUCTS COMPANY

30 Algonquin Road, Des Plaines, Illinois, U. S. A.

picco resins

You can specify PICCO RESINS with absolute confidence in the high quality of these fine materials. Carefully manufactured under rigidly controlled conditions in large quantities, their consistent uniformity assures trouble-free operation.

The trademark of quality

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CLAIRTON, PENNSYLVANIA

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## News in Brief

► A guide to ordering paper mill roll covers and cores has been included in a new catalog published by B. F. Goodrich Industrial Products Co. Catalog No. 9700 also contains information on the preparation of cores for recovering, roll storage and dynamic balancing of rolls.

► "Huber CWF," a new kaolin standard for the latex compounder and the textile industry, is described in a bulletin published by the J. M. Huber Corp., 630 Third Ave., New York, N. Y.

► Two new bulletins covering self-extinguishing properties of "Rigithane 112" foam and techniques and equipment for mixing the resin are available from the Thiokol Chemical Corp., 780 N. Clinton Ave., Trenton, N. J.

► Goodrich-Gulf Chemicals, Inc., 3121 Euclid Ave., Cleveland, Ohio, has released a 16 page data and specification book on its line of "Ameripol Micro-Black Masterbatch Synthetic Rubbers," which lists specifications on seven types of material.

► Goodyear Tire & Rubber Co. has issued a booklet on "Plioflex" synthetic rubber, which describes the types of Plioflex, its properties and applications.

► An index issued by the Naugatuck Chemical Division of the U. S. Rubber Co., Naugatuck, Conn., contains a complete listing of Naugatuck rubber chemicals technical literature.

► The June, 1959, issue of *Rubber Chem Lines*, published by the Rubber Chemicals Department of the American Cyanamid Co., deals with "Equivalent Cure Rates for Natural Rubber"; "Translucent Soling Stock"; "Pepton 22 Plasticizer in SBR"; and other topics.

► E. I. du Pont de Nemours & Co., Inc., Wilmington, Del., has released a paper by C. E. McCormack of the company's Elastomer Chemicals Department, entitled "Twenty Years' Experience with Neoprene in the Wire and Cable Industry." The paper was presented before the Middle Eastern District Meeting of the American Institute of Electrical Engineers.

► A data sheet giving information and specifications on attrition mills is being offered by the Munson Mill Machinery Co., Utica, N. Y.

► Bulletin 110, issued by the Thiokol Chemical Corp., 780 N. Clinton Ave., Trenton, N. J., deals with "The Resistance of Butyl Rubber to Water Absorption."

► The "1959 Super Service Data Book," which gives information on tires and auto accessories, is available through the Seiberling Rubber Co., Akron, Ohio.

## with

# HYDROXYLAMMONIUM SULFATE

Hydroxylammonium Sulfate—$(NH_2OH)_2 \cdot H_2SO_4$—is an excellent non-discoloring short stopper for use with peroxide-catalyzed polymerizations. It is used in the production of butadiene-acrylonitrile rubber and other polymers.

| Physical Properties | HYDROXYLAMMONIUM SULFATE |
|---|---|
| Formula | $(NH_2OH)_2 \cdot H_2SO_4$ |
| Molecular Weight | 164.14 |
| Melting Point, °C | 177* |
| pH of 0.1 M Aqueous Solution at 25°C | 3.7 |
| Solubility in 25°C, g/100 g solvent | |
| In Water | 63.9 |
| In 95% Ethanol | 0.2 |
| In Methanol | 0.1 |

*Melts with decomposition.

"HS" destroys the peroxide polymerization catalyst as soon as polymerization has progressed to the desired stage. Products of decomposition are oxides of nitrogen which do not remain in the final product. "HS" is adaptable to both hot and cold polymerizations.

Some reports indicate improvement of rubber quality when "HS" is used. It has been found, too, that on a cost-efficiency basis, Hydroxylammonium Sulfate actually is more economical than some commonly used short stoppers.

*Write for sample and technical data.*

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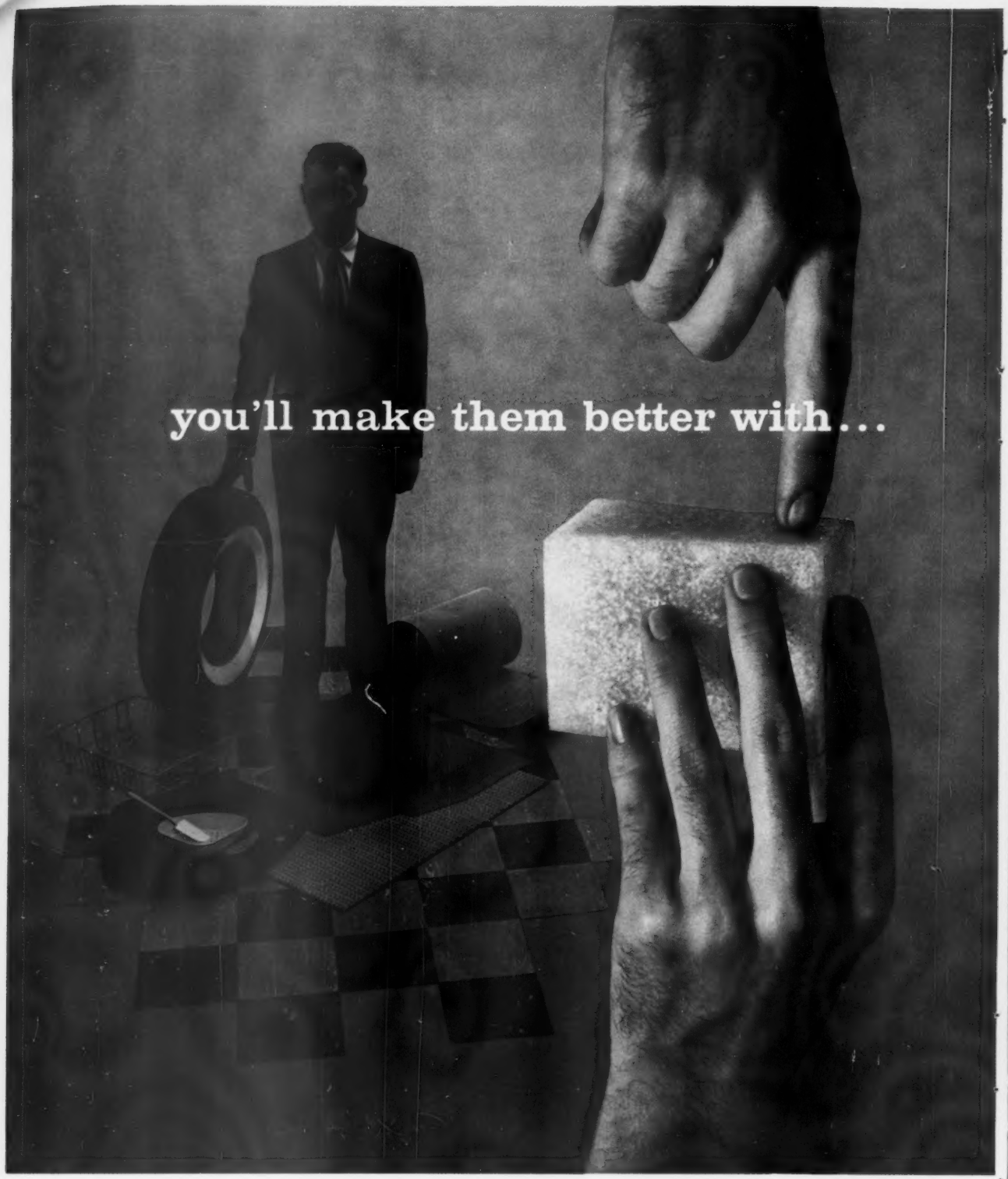


# NEW POLYSAR S-630

**An easy-processing "hot" rubber that won't stain – won't discolour!**

POLYSAR

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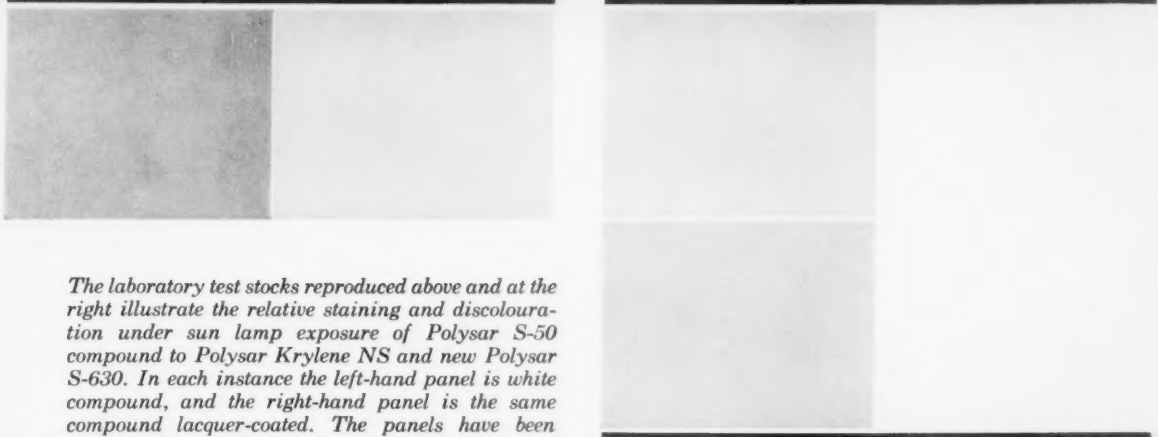
SYNTHETIC RUBBERS

**Polysar S-50**

**Polysar S-630**



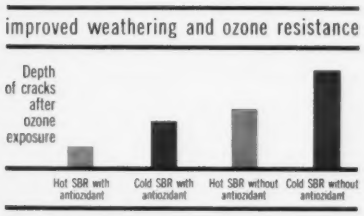
*The laboratory test stocks reproduced above and at the right illustrate the relative staining and discolouration under sun lamp exposure of Polysar S-50 compound to Polysar Krylene NS and new Polysar S-630. In each instance the left-hand panel is white compound, and the right-hand panel is the same compound lacquer-coated. The panels have been exposed under two 275-watt reflector sun lamps for 24 hours.*

**Polysar Krylene NS**

# NOW... all the inherent advantages of "hot" SBR *Plus light colour, non-staining, non-discolouring*

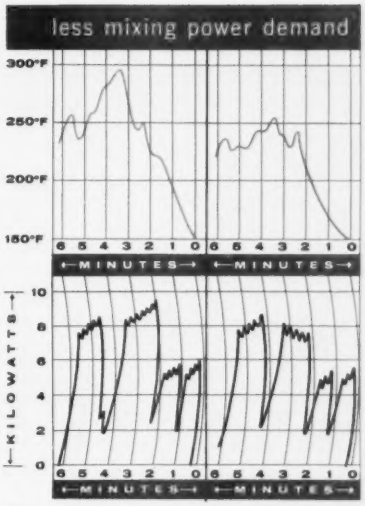
With the introduction of Polysar S-630, Polymer now brings you the easy processing, weathering resistance qualities of "hot" rubber plus new lightness of colour and improved non-staining, non-discolouring properties.

This new Polysar rubber thus brings substantial improvements to white or coloured tire sidewalls, non-staining carcass stocks for passenger tires and beadwire covering, conveyor and transmission belt carcasses; sponge products, such as rug underlay and weatherstrips; floor tiles; battery boxes and other ebonites; vacuum-moulded automobile floor mats, and cements.


improved weathering and ozone resistance
Depth of cracks after ozone exposure
Hot SBR with antiozidant
Cold SBR with antiozidant
Hot SBR without antiozidant
Cold SBR without antiozidant

*The chart above shows the marked improvement in weathering and ozone resistance achieved by new Polysar S-630. The depth of cracks after ozone exposure in "hot" SBR compounds without antiozidant is almost two-thirds less than in similar compounds based on cold SBR. When both rubbers are protected with an antiozidant the depth of cracks developed in the "hot" SBR is less than half the depth of those recorded in cold SBR.*

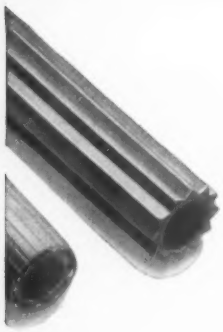
In the manufacture of high impact polystyrene, the same degree of improvement in impact resistance given by cold rubber is attainable with smaller quantities of Polysar S-630. In almost every product where colour stability is important, this new rubber brings new advantages.




*The top chart records temperatures of cold and hot SBR compounds during Banbury mixing. The lower chart shows the corresponding power demands. Note the substantially lower temperatures and lower power demands of the Polysar S-630 compound.*

*Polysar S-630 is the subject of our Polysar Technical Report No. 7:12A. Write for a copy.*

**POLYMER CORPORATION LIMITED • SARNIA • CANADA**



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*Permit 20 to 30 set-up changes per shift*
*Make 250 to 3000-plus cuts per minute*

Low, low set-up time from 1 to 7 minutes —average time 4 minutes.

Now couple this fast change-over feature to production advantages like these:

- **Incorporates easily into automated extrusion lines.**
- **Cuts *HOT*—right at extruder plate, if desired.**
- **Cuts raw or cured rubber, plastics, other materials in diameters up to 3", in lengths from 1" to 3" up to 60 feet or more, hot, cold, wet, dry or sticky without distortion or collapse.**
- **Change length instantly while running.**
- **Precision cutting to thousandths of an inch—tenths of a gram, or less.**
- **Eliminates die cutting, sheeting and rework of waste. Cuts 1/16" thick slices on small diameters—1/8" slices from 2" diameter extrusions at 1,000 pieces per minute.**
- **Self-sharpening feature means longer knife life—low maintenance.**
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**1250 E. 222nd Street**
**Cleveland 17, Ohio**

MOTCH AND MERRYWEATHER

# MONSANTO RUBBER CHEMICALS ANSWER ANOTHER IMPORTANT COMPOUNDING

## QUESTION:

**What economical vulcanizing agent can give my stocks highest heat resistance and more safety from scorch with no bloom or discoloration?**

## ANSWER:

**SULFASAN R dithioamine vulcanizing agent**

You can get the best heat resistance at a reasonable cost *and* eliminate bloom in your finished compounds by partial replacement of conventional curing agents with SULFASAN R. At the same time, this unique vulcanizing agent provides greater safety from scorch and can also boost modulus, lower compression set and improve aging.

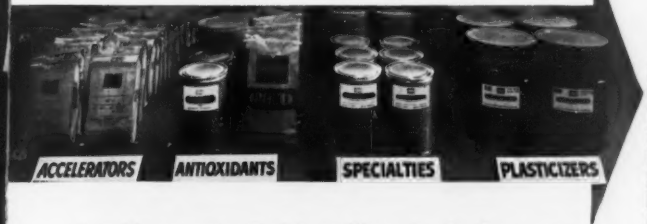
Economical SULFASAN R trims the cost of some compounds by reducing the total amount of vulcanizing agent required. As little as 0.8 to 2 parts of SULFASAN R per hundred of rubber, plus a small amount of THIURAD (tetramethylthiuram disulfide) or a similar curing agent, is usually sufficient to achieve good results in GR-S, butyl, nitrile and natural rubbers. For more information, use the convenient coupon.

**HEAT RESISTANCE**

| COMPOUNDS | A | B |
|---|---|---|
| Nitrile Rubber | 100 | 100 |
| Zinc Oxide | 5 | 5 |
| Stearic Acid | 1 | 1 |
| FEF Black | 40 | 40 |
| THIURAD | 3.50 | 0.80 |
| SULFASAN R | — | 0.80 |
| CURING AGENT COST | $3.99 | $2.15 |
| **RESULTS** | | |
| Mooney Scorch (Mins.), Large Rotor @ 250° F. | 12.5 | 31 |
| Compression Set | 27% | 24% |
| 70 Hrs./100° C. Blooming | 1 day | None in 9 months |
| Unaged | | |
| Tensile, psi | 2480 | 2520 |
| Elongation, % | 530 | 500 |
| Hardness | 64 | 65 |
| Aged 70 Hrs./300° F. | | |
| Tensile, psi | 600 | 780 |
| Elongation, % | 20 | 30 |
| Hardness | 85 | 87 |

See how a lower-cost SULFASAN R/THIURAD curing system compares with THIURAD alone in a heat-resistant nitrile rubber compound.

SULFASAN, THIURAD: Monsanto T.M.'s, Reg. U.S. Pat. Off.

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Monsanto Chemical Company
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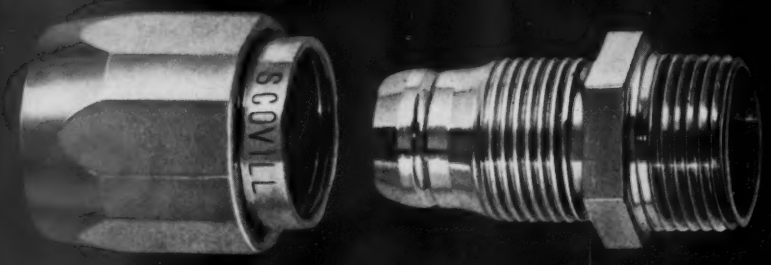
# Re-attachable coupling




# for gas pump hose

## The New Coupling

This leakproof 590-H Series re-attachable coupling consists of a collar and shank. Made from brass rod with polished chrome plated surface, the coupling grips hose with a positive, slip-proof grip. Can be attached and re-attached to hose with ordinary vise and wrench.

## The Fastest Delivery

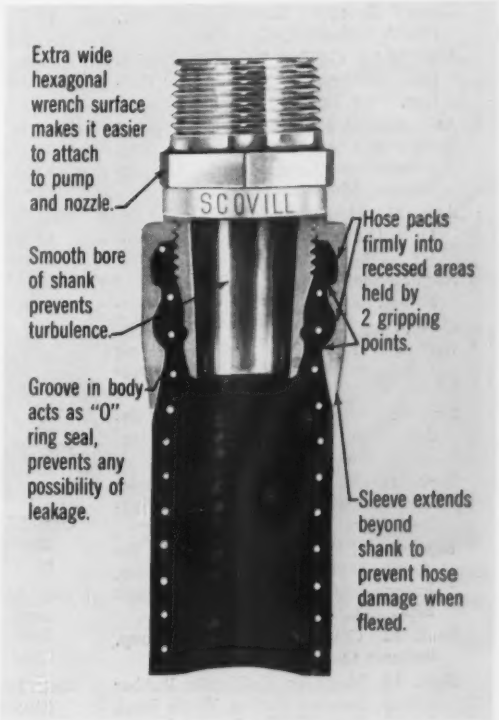
Only Scovill with its nation-wide network of sales offices and warehousing facilities can give you such fast delivery. All orders for the new re-attachable coupling for gas pump hose are processed and shipped *immediately!* No waiting . . . no delays. Scovill's stock insures prompt delivery.

## The Finest Service

When you specify Scovill re-attachable couplings for gas pump hose, you get the services of the largest and finest sales force in the industry today. It is available for consultation anytime, anywhere!

## For Facts and Figures

on 590-H series re-attachable couplings, write: Scovill Manufacturing Company, Hose Coupling Department, Waterbury 20, Conn.


Extra wide hexagonal wrench surface makes it easier to attach to pump and nozzle.
SCOVILL
Smooth bore of shank prevents turbulence.
Groove in body acts as "O" ring seal, prevents any possibility of leakage.
Hose packs firmly into recessed areas held by 2 gripping points.
Sleeve extends beyond shank to prevent hose damage when flexed.

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**San Francisco:** 434 Brannan St.
**Los Angeles:** 6464 E. Flotilla St.
**Toronto:** 334 King St., East

# coming events

**July 24.** Chicago Rubber Group, Golf Outing, St. Andrews Country Club, Chicago, Ill.

**Aug. 4.** New York Rubber Group, Golf Outing, Forsgate Country Club, Jamesburg, N. J.

**Aug. 9-12.** Third Annual ASME-AIChE Heat Transfer Conference, University of Connecticut, Storrs, Conn.

**Aug. 10-13.** Society of Automotive Engineers, National West Coast Meeting, Georgia Hotel, Vancouver, British Columbia, Canada.

**Aug. 10-14.** Gordon Research Conference, Elastomers, Colby Junior College, New London, N. H.

**Aug. 16-Sept. 6.** International Union of Pure and Applied Chemistry, 17th International Congress and 20th Conference, Munich, Germany.

**Aug. 21.** Philadelphia Rubber Group, Golf Outing, Manufacturer's Country Club.

**Aug. 30-Sept. 3.** Frankfurt International Fall Trade Fair, Frankfurt, Germany.

**Sept. 2-4.** 1959 Cryogenic Engineering Conference, University of California, Berkeley, Calif.

**Sept. 7.** International Exhibition of Industry and Commerce, Rio de Janeiro, Brazil.

**Sept. 10-11.** ASME Wood Industries Conference, Multnomah Hotel, Portland, Ore.

**Sept. 10-11.** Society of the Plastics Industry, Midwest Section Conference, French Lick Sheraton Hotel, French Lick, Ind.

**Sept. 12.** Connecticut Rubber Group, Summer Outing.

**Sept. 12.** Northern California Rubber Group, Summer Outing, Turtle Rock Ranch, Danville, Calif.

**Sept. 13-18.** American Chemical Society, 136th National Meeting, Atlantic City, N. J.

**Sept. 13-17.** National Tire Dealers & Retreaders Association, Annual Convention, Washington, D. C.

**Sept. 21-25.** 14th Annual Instrument-Automation Conference and Exhibit, International Amphitheatre, Chicago, Ill.

**Sept. 22-Oct. 3.** London World Trade Fair, Alexandra Palace, London, England.

**Sept. 24.** Fort Wayne Rubber & Plastics Group.

**Sept. 27-30.** American Institute of Chemical Engineers, St. Paul, Minn.

**Sept. 28-30.** American Oil Chemists' Society, Hotel Statler, Los Angeles, Calif.

**Sept. 28-Oct. 2.** 14th Annual National Hardware Show, New York Coliseum, New York, N. Y.

**Oct. 1-2.** Society of the Plastics Industry, 15th New England Section Conference, Wentworth - by - the - Sea, Portsmouth, N. H.

**Oct. 2.** Detroit Rubber and Plastics Group, Fall Meeting, Detroit Leland Hotel, Detroit, Mich.

**Oct. 2.** Philadelphia Rubber Group, Technical Meeting, Poor Richard Club, Philadelphia, Penna.

**Oct. 6-9.** Second International Symposium on "High Temperature Technology", sponsored by Stanford Research Institute, Asilomar, Calif.

**Oct. 6.** Los Angeles Rubber Group. Meeting sponsored by Plastic and Rubber Products Co., Biltmore Hotel, Los Angeles, Calif.

**Oct. 7.** Chemical-Finishing Conference sponsored by the National Cotton Council, Mayflower Hotel, Washington, D. C.

**Oct. 8.** Southern Ohio Rubber Group, Fall Technical Meeting.

**Oct. 11-16.** American Society of Testing Materials, Third Pacific Area National Meeting, Sheraton-Palace Hotel, San Francisco, Calif.

**Oct. 12-14.** 8th National Clay Conference, University of Oklahoma, Norman, Okla.

**Oct. 13.** Buffalo Rubber Group, Fall Meeting, Hotel Westbrook, Buffalo, N. Y.

**Oct. 13-14.** Society of Plastics Engineers, National Technical Meeting, Ambassador Hotel, Los Angeles, Calif.

**Oct. 16.** Boston Rubber Group, Fall Meeting, Somerset Hotel, Boston, Mass.

**Oct. 16.** New York Rubber Group, Fall Meeting, Henry Hudson Hotel, New York, N. Y.

**Oct. 17-25.** "Kuneststoffe 1959," International Trade Fair of the Plastics Industry, Duesseldorf, West Germany.

**Oct. 19-21.** National Paint, Varnish & Lacquer Association, Annual Convention, Chalfonte - Haddon Hall, Atlantic City, N. J.

**Oct. 19-23.** 47th National Safety Congress and Exposition, Conrad Hilton Hotel, Chicago, Ill.

**Oct. 20.** Elastomer & Plastics Group, Northeastern Section, ACS.

**Oct. 20-22.** 10th National Conference on Standards, Sheraton-Cadillac Hotel, Detroit, Mich.

**Oct. 21-25.** 4th Annual Instrumentation and Automation Show and Conference, Palazzo del l'Arte al Parco, Milan, Italy.

**Oct. 23.** Akron Rubber Group, Sheraton Hotel, Akron, Ohio.

**Oct. 26-31.** International Organization for Standardization, Technical Committee 45, Henry Hudson Hotel, New York, N. Y.

**Oct. 26-28.** Ninth Canadian High Polymer Forum, Guild Inn, Toronto, Ont., Canada.

**Nov. 3.** Los Angeles Rubber Group, Biltmore Hotel, Los Angeles, Calif.

**Nov. 5.** Rhode Island Rubber Group, Fall Meeting, Pawtucket Country Club, Pawtucket, R. I.

**Nov. 6.** Connecticut Rubber Group, Sports Night.

**Nov. 6.** Philadelphia Rubber Group, Annual Dance.

**Nov. 8-13.** Joint International Meeting of Division of Rubber Chemistry, ACS; Committee D-11, ASTM, and Rubber and Plastics Division, ASME, Shoreham Hotel, Washington, D. C.

**Nov. 8-10.** Toy Production Show, New York Trade Show Building, New York, N. Y.

**Nov. 16-20.** Automation Show & Conference on Materials Handling, New York Trade Show Building, New York, N. Y.

**Nov. 17.** Elastomer & Plastics Group, Northeastern Section, ACS.

**Nov. 29-Dec. 4.** ASME Annual Meeting, Chalfonte-Haddon-Hall, Atlantic City, N. J.

**Nov. 30-Dec. 4.** 27th Exposition of Chemical Industries, New York Coliseum, New York, N. Y.

**Dec. 3.** Fort Wayne Rubber & Plastics Group.

**Dec. 6-9.** American Institute of Chemical Engineers, Annual Meeting, San Francisco, Calif.

**Dec. 8.** Buffalo Rubber Group, Christmas Party.

**Dec. 11.** Boston Rubber Group, Christmas Party, Somerset Hotel, Boston, Mass.

**Dec. 11.** Detroit Rubber and Plastics Group, Christmas Party, Hotel Statler, Detroit, Mich.

**Dec. 11.** Los Angeles Rubber Group, Christmas Party, Beverly Hilton Hotel, Beverly Hills, Calif.

**Dec. 12.** Southern Ohio Rubber Group, Winter Meeting.

**Dec. 18.** New York Rubber Group, Christmas Party.

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To impart the SP properties, lump and other high grade scrap produced on estates is blended with a rubber masterbatch crumb in definite proportions. SP brown crepe is cleaner than brown crepe from scrap alone and is generally lighter in colour. It is prepared under license from the Rubber Research Institute, Malaya and every batch has to conform to technical specifications to ensure uniformity.

SP brown crepe is recommended for all uses for which the better grades of scrap rubber are suitable. It gives better quality extrusions of finer finish and improved physical properties. It is available through the normal trade channels.

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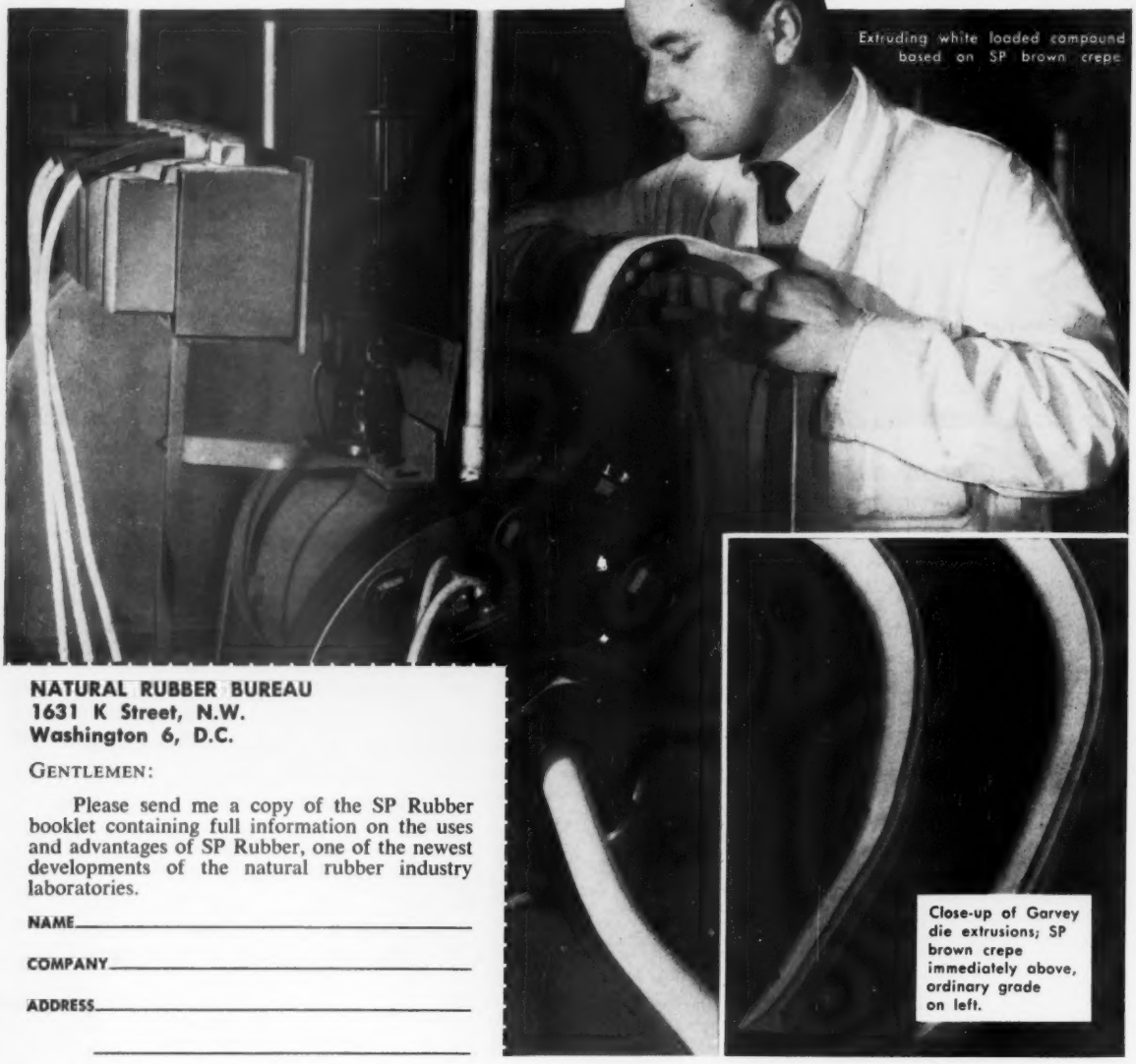

Extruding white loaded compound based on SP brown crepe

Close-up of Garvey die extrusions; SP brown crepe immediately above, ordinary grade on left.

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## Overseas

**Paris**—Goodyear Tire & Rubber Co. plans to build a $7 million ultramodern tire plant in France at a site to be selected. To employ about 500 workers, the facility will have an initial annual capacity of 15 million pounds.

**Kuala Lumpur**—A wage agreement signed by the Malayan Planting Industries Employer's Association and the National Union of Plantation Workers early this year, has come into effect. Rubber tappers receive a guaranteed wage and extra payments for the average poundage of latex brought in.

**The Hague**—Continental Carbon Corp. plans to build a carbon black factory in the Botlek region of the Netherlands which will be operated by a company subsidiary, Continental Carbon Nederland N. V. Capital will be entirely in the hands of the American firm.

**London**—Dunlop Ltd. has installed new electronic machinery at its Birmingham plant which operates on a time-temperature basis to control the mastication of crude rubber and the mixing of the ingredients that go into a tire. The installation is said to have reduced the amount of skilled supervision necessary and to have eliminated faulty mixing.

**Oslo**—Manufacture, under license, of United States' industrial products is sought by the Norwegian firm, Gummifabriken National A/S to compliment and expand the firm's production of related items. Gummifabriken specializes in the manufacture of industrial hose of all types, plumbing articles, rubber stripping, rubber rings and similar products.

**Tokyo** — Shiraishi Kogyo Kaisha, Ltd., Osaka, Japan, is producing a line of precipitated calcium carbonates called the Red Ball brand and prepared by a patented process of the Japanese government.

**Rome**—Commercial production of polypropylene textile fibers will begin in Italy at the end of this year at the Montecatini Soc. Gen. in Milan.

**London**—A new modern laboratory, devoted to development work on neoprene and other synthetic rubbers and rubber chemicals for the European rubber industry, has been opened by the DuPont Co. (United Kingdom) Ltd. at Hemel Hempstead. Designated the Elastomers Research Laboratory, this is the first permanent facilitiy to be completed by DuPont in Europe.

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# Why CONSISTENT GRADE UNIFORMITY is virtually an *exclusive* characteristic of LEAD-FREE ST. JOE ZINC OXIDE

We produce some 40 different grades of zinc oxide — each with different physical and chemical properties. But while these grades differ from one to another, *each specific grade is consistently uniform in its individual characteristics* whether produced today, next month or next year.

**AND ST. JOE'S UNIQUE METHOD OF HIGH-SPEED CONTINUOUS QUANTITATIVE ANALYSIS IS YOUR GUARANTEE**

The tonnage production of zinc oxide could make the ordinary 6 to 8 hour routine oxide analysis by standard wet lab methods costly to both producer and consumer. If metallic impurities are not eliminated immediately, the 6 to 8 hour interim between oxide sampling and a complete analysis can easily result in tons of off-standard oxide.

Only by a *continuous* analytic method can operators determine the frequent furnace adjustments necessary to minimize off-standard ZnO. To accomplish this, St. Joe uses a Baird-Atomic Direct Reading Spectrometer—ANALYSIS TIME HAS BEEN REDUCED TO LESS THAN 20 MINUTES!

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Once you have selected the specific grade of St. Joe Zinc Oxide that meets your requirements, *you can set your processing — our oxide will not change.* You will be using oxide with purity and uniformity factors unequalled in the industry.

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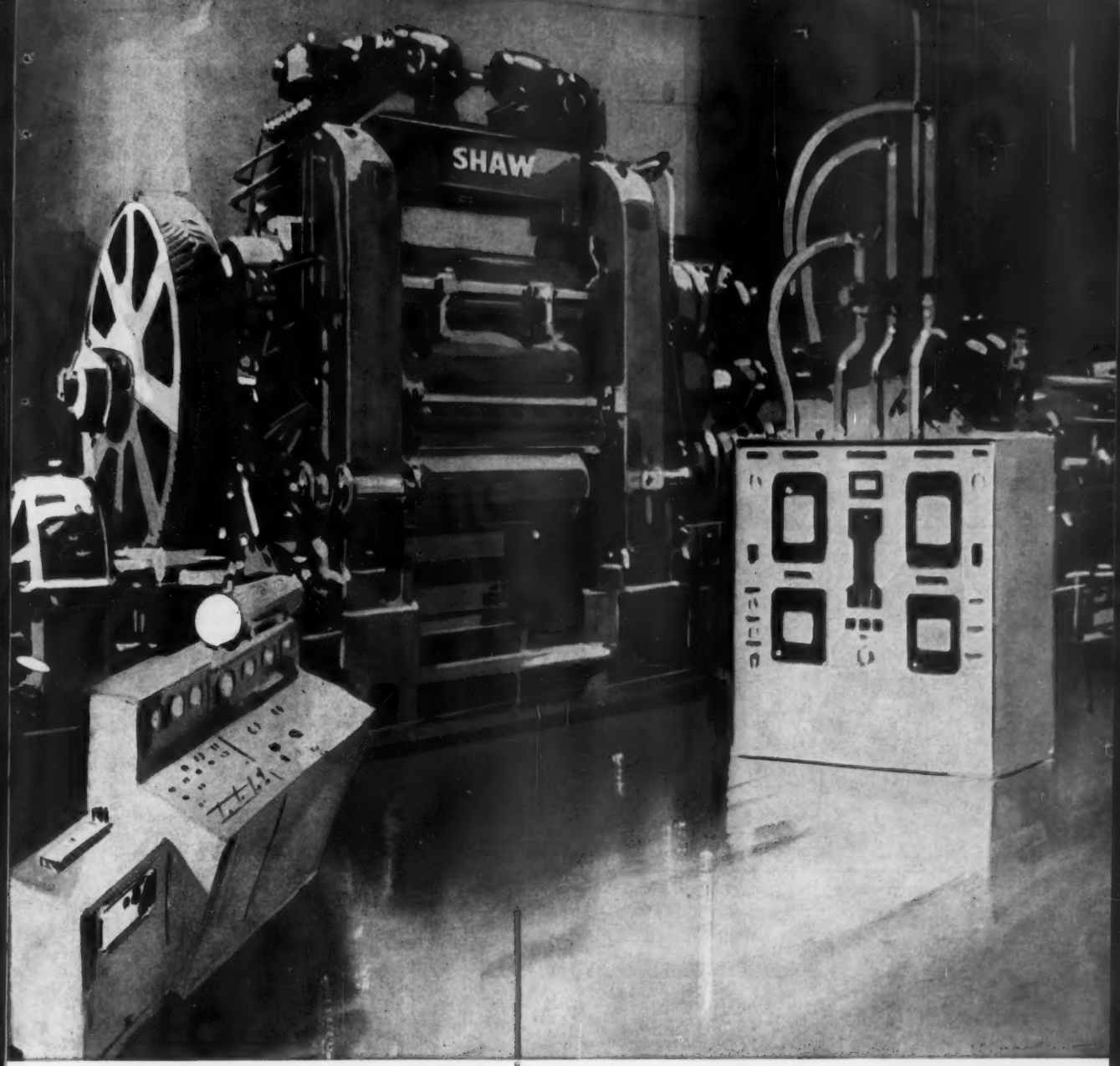


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4. Flood lubrication.
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OVERSEAS AGENTS THROUGHOUT THE WORLD

P.2507

The Case of The
Secretary's Secret
...AND I HEAR IF YOUR BOSS DOESN'T WHIP THIS SOLVENT PROBLEM HE'S GOING TO BE FIRED!!
GOLLY... SUCH A NICE GUY... I WONDER IF...

...AND SINCE THE COMPANY I USED TO WORK FOR HAD THE SAME PROBLEM, I THOUGHT MAYBE...
WELL, DON'T KEEP IT A SECRET... I'M REALLY ON THE SPOT!!

...AND SKELLYSOLVE IS SHIPPED IN SPECIAL TANK CARS TO ELIMINATE CHANCE OF CONTAMINATION.
1. Skellysolve is quality-checked during production and before shipping.
2. Technical service backed by 25 years of Skelly experience.
3. Orders phoned direct to Skellysolve plant.
4. 9 out of 10 cars shipped next day.
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CONGRATULATIONS!! I HEAR YOU'RE IN SOLID WITH THE BOSS SINCE YOU WHIPPED THE CONTAMINATION PROBLEM!!
THANKS TO YOUR TIP ON SWITCHING TO SKELLYSOLVE!!
ONE MONTH LATER

**When solvents are so important** to your business, why take chances on quality or delivery? Next time you order specify Skellysolve.

SKELLY **Skellysolve**

**SKELLY OIL COMPANY**

**Industrial Division**

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**SKELLYSOLVE-B.** For making quick-setting cements for the shoe, tape, container, tire and other industries. Quick-drying, with no foreign taste or odor in dried compound. Closed cup flash point about —25°F.

**SKELLYSOLVE-C.** For making quick-setting cements with a somewhat slower drying rate than those compounded with Skellysolve-B. Closed cup flash point about 13°F.

**SKELLYSOLVE-H.** For general use in manufacturing operations and cements, where faster evaporation rate than that of Skellysolve-C is desired. Closed cup flash point about —16°F.

**SKELLYSOLVE-L.** For general manufacturing operations where a medium evaporation rate is required. Closed cup flash point about 12°F.

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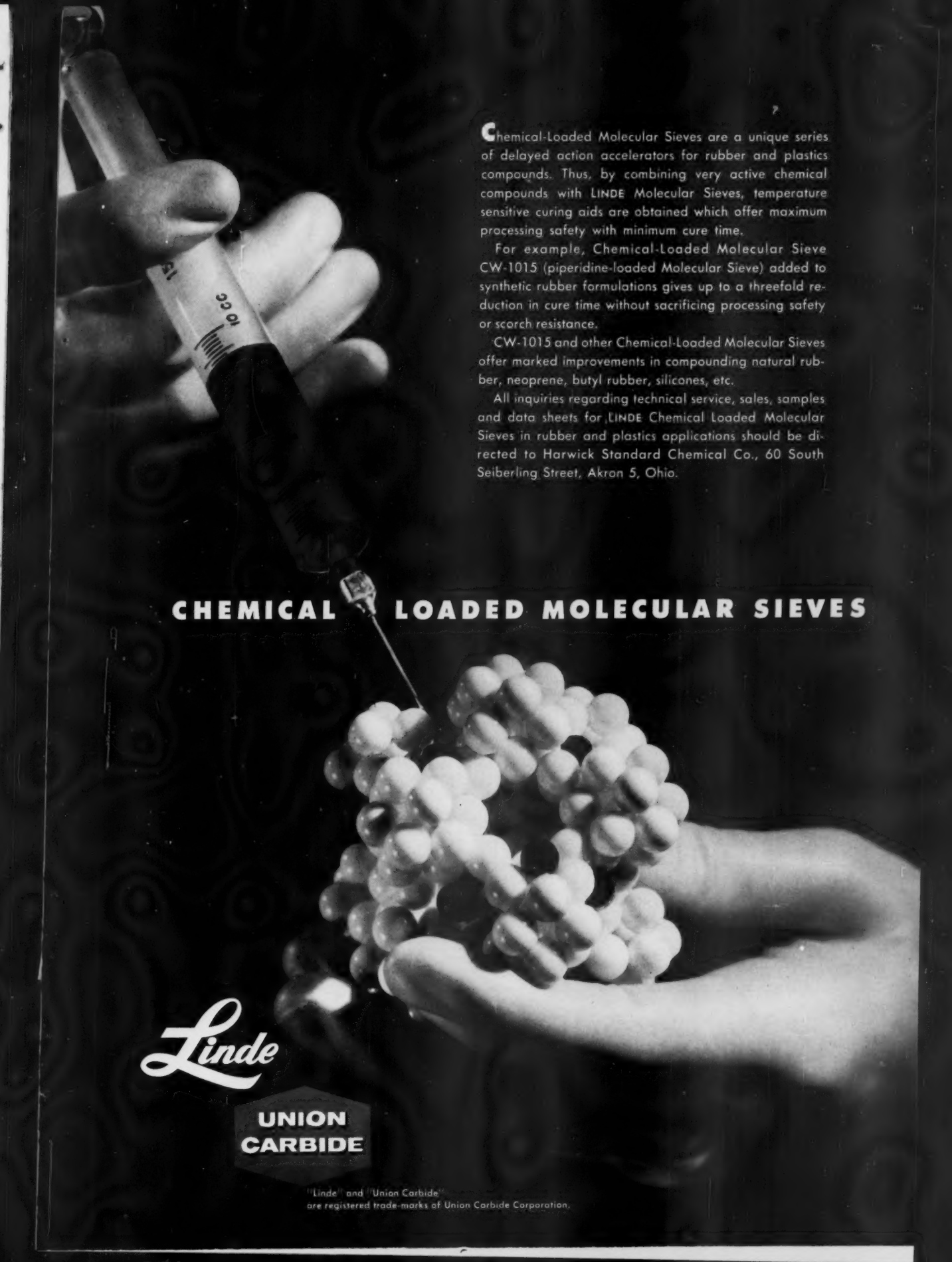


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| 9199 | 100 | 1500 | — | — | 50 | HAF |
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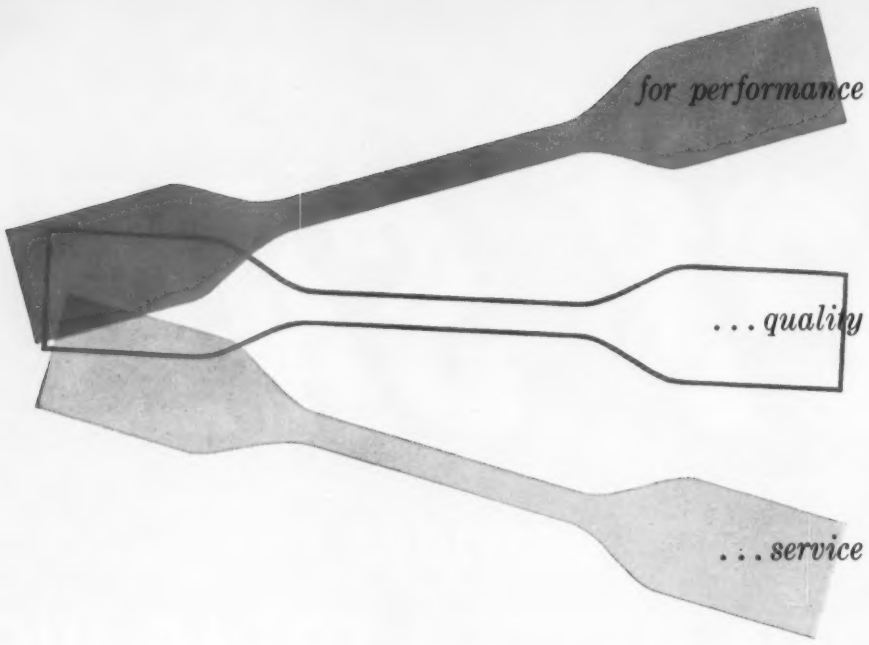


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• Members of the German Association of the Rubber Industry, which consists of 170 companies, sold merchandise amounting to 2.5 billion German marks (approximately $620 million), during 1958. This is an increase of about 6.4 per cent over last year's results. The domestic market absorbed rubber goods amounting to 2.1 billion DM (an increase of 7½ per cent), and about 310 million DM (approximately $80 million) were shipped to various countries in the world.

All told, 415,157 tons of rubber goods were produced. German factories consumed about 165,781 tons of natural and synthetic rubber; natural rubber amounted to 115,732 tons, whereas synthetic rubber was processed at the rate of 50,049 tons. Consumption of synthetic rubber increased by 10 per cent in 1958 and at present, amounts to 30.2 per cent.

• As Superior Processing natural rubber was previously available only as first quality sheet or crepe, the recent introduction of SP brown crepe represents important progress. It has been developed to meet the needs of manufacturers who have asked for SP properties in the lower grades of natural rubber. SP brown crepe, which has a 20/80 ratio of vulcanized/unvulcanized components, as in SP sheet and SP crepe, possesses all the characteristic SP properties. One of its outstanding properties is the ability to give smooth extrusions in compounds having high rubber content where a processing aid would normally be employed and where, in consequence, compound formulae can be simplified and vulcanizate properties improved.

The greatly reduced die swell, higher compound viscosity and faster curing rate of extrusion compounds based on SP brown crepe result in greater output with more accurate conformity to die dimensions and less collapse of unsupported sections. For trial purposes, laboratory samples and/or 224 pound bales of SP brown crepe are available from the British Rubber Producers' Research Association, 56 Tewin Road, Welwyn Garden City, Herts., England.

• Federation of British Industries is about to organize a British Exhibition, to take place in the Coliseum in New York in June, 1960. The exhibition will last for 14 days and is expected to be the largest ever staged by one country in the United States.

• Officials of the Thailand government and a Brazilian mission have agreed to promote two-way trade between those countries. Among items which Brazil is willing to purchase is Thai rubber.

• The Hungarian Palma Rubber-Heel factory is having considerable success with its inflatable rubber mattresses, according to the *Hungarian Exporter*. A Hungarian concern, Vegyterv, is now designing seven plastics manufacturing plants for the Soviet Union and a considerable part of the machinery for these plants is to be produced by Hungarian industry. The *Hungarian Exporter* also reports on the progress of other rubber and plastics manufacturing companies.

Hungarian plastics factories have been successful in building trade with drain and pressure pipes made from PVC, and among the most recent products are a polyethylene bottle and drinking cup packaged in a plastic container. A foam material Sztirocell, will soon be produced by a company which uses a process developed by the Budapest Research Institute for Plastics. Several new articles and goods of improved quality are being put on the market by the Hungarian Works. Inflatable rubber toys are very popular and the company recently received a large order to be exported to Western Europe.

• Lemfoerder Metallwarengesellschaft G.m. b. H. has obtained a patent covering a spring assembly or mounting for machinery consisting of a layer of polyurethane with a foam-like structure sandwiched between two nonmetalic plates of relatively rigid material. These plates are preferably made of solid polyurethane but other materials it can be made from are wood, ceramics and synthetic resins. The exposed surface of the foam-like polyurethane may be covered with a layer of solid polyurethane of a softer quality than that used for the plates. The spring assembly is highly resistant to compression, fatigue, oil and deterioration by aging.

• Impurities can be removed from polyethylene produced by low-pressure polymerization by treating the polyethylene with a dilute solution of high-boiling mono- or polyhydric alcohol, according to a patent which was recently granted to Bergwerksgesellschaft Hibernia A.G. Discoloration of the polyethylene is thus prevented.

• Insulating materials for car wiring should, as a rule, be highly resistant to strong voltages and fairly resistant to both ionized air and heat since the cables run close to the motor and high voltage generators. Recommended for this use is an elastomer with few double-bonds such as Polysar Butyl 100.

The resistance of this rubber to ozone may be improved by adding a specific preservative. Extrudability may be adjusted by varying the relative proportions of fillers and plasticizers. The triple acceleration system allows quick vulcanizing with good mechanical properties. In the laboratory, the best extrusion results were realized with the extruder barrel heated at 65-70°C. (150-158°F.) and the head kept at 105-115°C. (220-240°F.). Optimum screw speed was 35 r.p.m.

• "How Will the European Common Market Influence the Rubber Industry?" is the topic of a feature article

# On the Continent (cont'd)

by the director of the Natural Rubber Bureau, H. C. Bugbee, which was published in the French *Revue Generale*. Mr. Bugbee points out that implications for the rubber industry of the major foreign trade developments in 1959 seem to add up to the following:

(1) The total European demand for rubber products will expand importantly in 1959, dramatically in 1960 and subsequent years.

(2) American export trade in many rubber product lines will diminish, as American investments in Western European manufacturing facilities rise sharply.

(3) Locally produced synthetic availabilities in Western Europe will be stepped-up at a faster rate than synthetic exports to Western Europe.

(4) As truck tire business will expand proportionately greater than other rubber product business, the demand for natural rubber from Western Europe will increase in spite of much larger synthetic availabilities.

We are in a rapidly expanding world economy sure to need more total rubber than most of us realize. There is no room in such an era for the philosophy of restriction of production or low-yield, high cost units. What is needed is the greatest possible production efficiency. This applies to both natural and synthetic. We are in for an era of many years duration where the emphasis must be on more research for more efficient production. In natural rubber, the time to replant and new-plant on the greatest scale in history is *now*. The demand is here to be met.

• In a recent edition of *Rubber Journal and International Plastics*, George A. Greenwood complains about the United States' attitude toward trade with Russia. First, he points out that repeatedly, attention has been drawn to great Soviet developments in both rubber and plastics. It is manifest that the vast increase in Russian imports of rubber will require far more machinery than the country possesses or is now capable of producing.

As to plastics, it will be remembered that a short while ago a Mr. Windsor visited Russia and some of the satellite countries and returned with very large orders. There have been interchanges of importance between West and East regarding inquiries in sales, but the members of the respective Russian trade delegations which have been in England during the past year or two have pointed out that transactions so far are just a fleabite compared with what the USSR would buy if only peace can be preserved and Russia can find the money.

It is interesting to note that Mr. Greenwood complains about our attitude saying: "It is very disconcerting to know that a good deal of this prospective trade is being held up through the refusal of those who hold United States patents or 'know-how' to permit their use and exploitation by the British firms which share them, simply because of American 'touchiness' over East-West trade, a refusal which without some protracted negotiations might hold up for a long time any sort of bargain which could be entered into between London and Moscow if we can only place bigger sterling credits at Russia's disposal."

It seems to us, that America is not refusing to trade with anyone who has the same good will as she has. But we do not want another Munich. We still remember Mr. Chamberlain descending from his plan on his return from Germany and showing the piece of paper which guaranteed the peace of the world for a long time to come. Repeatedly authorities have pointed out that a treaty with Russia is not worth the paper it is written on.

As long as Russians refuse to obey the rules which control and govern the entire world, meaning the free world, we in turn will be very, very reluctant to do business with that country, whose understanding of many things is quite different from ours. It is for this reason that we believe that Mr. Greenwood will have to be a little bit more patient, and possibly in a not so distant future he might be grateful to Americans for their reluctance to do business with a part of the world where it is not treated as an equal.

• The post of British scientific attache to the British Embassy in Moscow has been newly created. The scientific attache will advise the British Ambassador on scientific questions and report on Soviet scientific and technical developments. The British Government has appointed Mr. Senior, who has been engaged in dealing with problems of instrumentation and combustion. Mr. Senior will deal exclusively with problems of industry, trade and commerce after arriving in Moscow. We hope he will succeed in removing the restrictions which the Soviets have imposed upon foreign personnel, which confines them to certain areas, particularly to Moscow and other major cities, and does not permit them to roam around freely in the country. This, by the way, is one of the reasons why the United States is getting tough in dealings with the Soviet Union.

• A new crude-oil refinery went on stream a few days ago in Cologne at the terminal of the new German pipe-line which starts in Wilhelmshaven and brings oil down almost to the center of West Germany. This refinery will also supply part of the requirements of the chemical industry, particularly petrochemical material. About 45,000 tons of ethylene, 35,000 tons of propylene and 7500 tons of butadiene can be supplied during a year. Some of the major customers have arranged for their own pipe-lines so that the delivery of the chemicals can be made directly through these private pipes which lead directly into the customer's plants. According to the German press, Esso has a major interest in the new refinery.

• Dunlop Rubber Co., Ltd. in London, was able to increase its net profit from 5 to 5.8 million pounds (approximately $2 million) during 1958. Consequently the dividend has been increased from 14 to 16¼ per cent and, in addition, one new share has been issued free of charge with each group of four shares. The increased demand and requirements of the automobile industry are responsible for this development in the profit picture in England.

# 朗白

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RUBBER AGE, Vol. 85, No. 4/July, 1959

# Drying Black Rubber

**A pilot plant features an improved two-stage drying technique which represses fines and fire**

By G. L. HELLER, J. W. WHITE
*Columbian Carbon Co., Monroe, La.*

and H. A. BRAENDLE
*Columbian Carbon Co., New York, N. Y.*

BLACK rubber is a new designation coined specifically to describe a masterbatch of carbon black and rubber made according to the principles discovered by Columbian Carbon Co. research. This is a process in which carbon black is dispersed in water alone by physical means rather than chemical. In the process of wedding itself to the rubber latex particle, the carbon acts as a creaming agent. This new name has been selected to distinguish the new product from masterbatches made in the Banbury or masterbatches made from a slurry with dispersing agents and stabilizing agents added to the carbon black prior to blending with the latex. To date, black rubber has been made commercially in synthetic rubber only.

Columbian research has come up with a new drying technique for black rubber crumb which brings a step closer the ideal sequence of carbon-rubber reinforcement, namely, dispersion in rubber at low temperature prior to "setting" of the carbon gel by heat. It also shows promise of being economically attractive.

## Carbon Gel

In the study of the carbon reinforcement of rubbers, and particularly that of butadiene-styrene types, Columbian Carbon Co. research has added a number of new concepts of a generic character.

Early attempts to apply Fielding's *(1)* teachings on bound rubber to butadiene-styrene rubbers were discouraging. With the synthetic polymer, in contrast to Hevea, the insoluble fraction is a mixture of carbon-bound rubber and cross-linked polymer without any carbon in it. For that reason, the designation "carbon gel complex" or "carbon gel" for short was introduced. It was found that the adsorption of carbon black by synthetic rubber or carbon gel had a positive temperature coefficient *(2)*. This discovery pointed to a chemical factor in the carbon-rubber bond concept of reinforcement.

It is now generally conceded that the carbon gel complex is the working unit in the reinforcement of both synthetic and natural rubber and, by proper mixing procedures, tread wear and performance can be

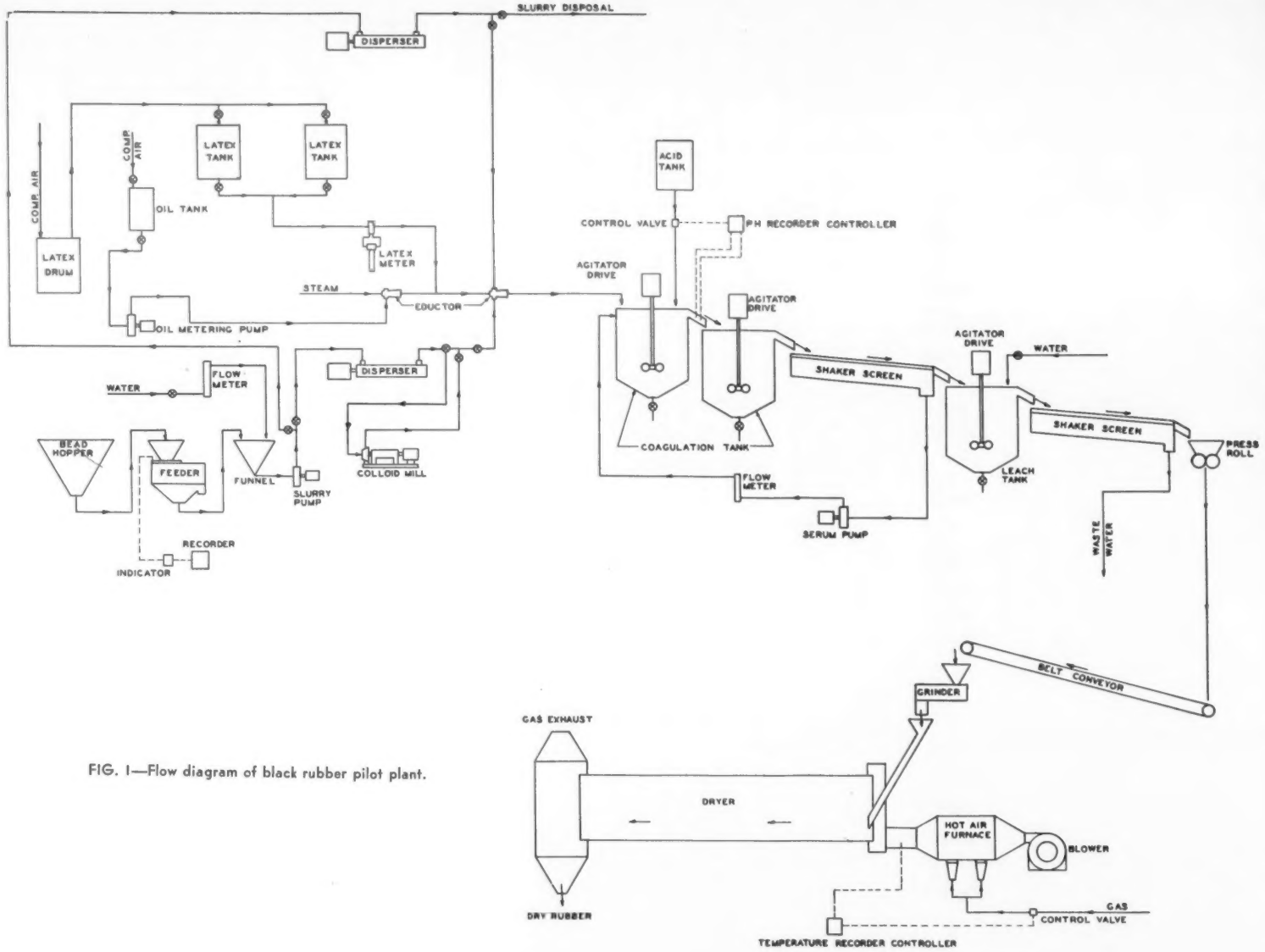


FIG. 1—Flow diagram of black rubber pilot plant.

enhanced by optimum application of the carbon gel concept *(3, 4, 5)*. Application of basic principles in production practice often runs into difficulties, and this is equally true of the carbon gel concept. Ideally the carbon black should be particulately dispersed through the synthetic rubber at a low temperature and then the temperature of the masterbatch raised to the 300°F. range to enhance the strength of the rubber-to-carbon bond. Thus:

> "From these various investigations in cold rubber the development of the carbon gel complex is pictured as involving three distinct but not necessarily separated steps, as follows:
>
> "Step 1: The complete wetting of all the carbon black by polymer with the coincidental development of primary carbon-rubber bonds by an adsorption mechanism. In this initial stage the masterbatch is completely soluble in benzene, forming a colloidal black cement.
>
> "Step 2: The knitting of these colloidal primary carbon gel units into an insoluble lattice structure co-extensive with the unvulcanized stock, by either additional or stronger carbon-rubber bonds and by secondary polymer cross-links within the lattice structure. This lattice, containing all the carbon, sets the pattern for the performance of the vulcanized stock in terms of those properties such as tensile which are dependent on the primary carbon-rubber bond. It is worthy of note that this carbon-rubber bond is formed without the aid of a sulfur bridging agent.
>
> "Step 3: The stiffening of this lattice by the development of further secondary cross-links within the lattice and in addition possibly by the development of polymer gel containing no carbon but associated with the carbon gel lattice. In this step heat plays the major role. This increase in carbon gel level with heat is associated with increased viscosity in the unvulcanized stock and with enhanced modulus and hardness properties in the vulcanizate." *(6)*

> "The fixing or stabilizing of the carbon black dispersion by heat should follow the development of an adequate dispersed condition during the early stages of mixing. This preferred approach has been discussed in previous publications, in connection with the investigation of carbon-gel development in SBR systems. As demonstrated throughout these studies, steps that develop an improved state of dispersion in rubber compounds result in improved physical properties of the vulcanizate, in terms particularly of tensile strength, elongation, tire wear, and resistance to cracking." *(7)*

In an industry as competitive as the rubber industry, the movement to hotter mixing and faster mixing as in high-speed, high-pressure Banburys or in fully loaded Banburys of conventional type, has made the attainment of this ideal procedure progressively more difficult to attain.

## Black Rubber Process

The black rubber process developed by Columbian Carbon *(8, 9)* is an outgrowth of a concept older than vulcanization itself, a patent on latex compounding having been granted to Thomas Hancock in 1830, nine years before Charles Goodyear discovered vulcanization. With the acceptance, around 1920, of the unique reinforcing properties of carbon black in natural rubber, there was a sharp revival in the interest in latex compounding, particularly as applied to carbon black. During World War II and under Government sponsorship, another forward step was taken in the manufacture of carbon black SBR masterbatches. This was essentially a batch process and with the postwar return of the rubber industry to private hands, dissatisfaction with the quality of this black masterbatch caused its consumption to fall off. With the adoption of the basic ideas and principles of the Columbian process *(10)* by a considerable block of the synthetic rubber producers, black masterbatch production or, more correctly, black rubber production, is undergoing a sharp increase.

FIG. 2—Feeder end of pilot plant.

## A New Black Rubber Pilot Plant

Encouraged by the industry's adoption of its process, Columbian erected a new streamlined pilot plant for the production of black rubber in order to continue its studies of reinforcement. Figure 1 is a flow diagram of our new pilot plant including the new drier for the black rubber flakes.

Figure 2 shows the feed end of the line. On the right, one only of the latex tanks may be seen. Latex is air-pressure fed to the dispersion system. In the center is the carbon black feeding and metering system. Both of these are charged from the adjacent room, the black system being equipped with an exhaust arrangement to take care of any fly loss. Below

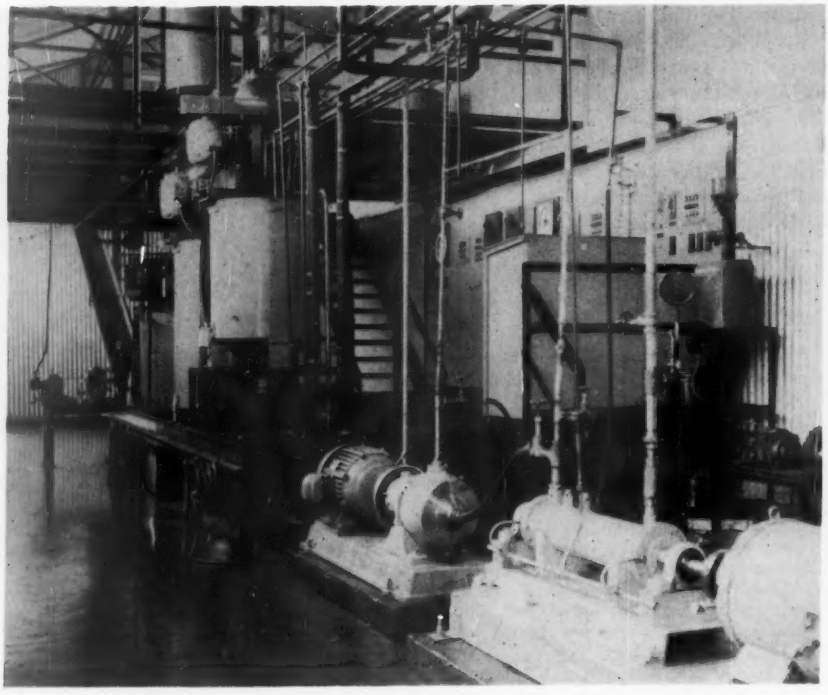

FIG. 3—Dispersion and coagulation equipment.

the black storage hopper is the automatic weigh feeder which discharges into a funnel where the water for the making of the black slurry is added. At the bottom may be seen the small centrifugal pump which carries the weight-controlled black feed and the metered water over to the dispersion equipment shown in Figure 3.

Columbian investigated many systems of dispersion and many varieties of dispersion equipment as part of its basic research, but currently we are using a Columbian bead disperser followed by a Charlotte colloid mill shown in the foreground of Figure 3. In the background and to the right can be seen the oil tank with its heater and positive displacement pump to feed oil into the system. In the complex of piping above the dispersion units are mixing nozzles, valves and metering connections, where the various streams of latex, black slurry and oil are brought together. The blend is discharged into a 100-gallon stainless steel coagulation tank shown next in the line where the acid coagulation starts. Just beyond is the soap conversion tank of 200-gallon capacity and, following it, the reslurry or leach tank. Between these last two, there is a Syntron vibrator screen feeder which takes off the serum from the coagulation and soap conversion steps. This permits recycling this acid water with additional acid make-up gravity fed from the overhead tank shown on the upper level in Figure 3.

In Figure 4 we illustrate one innovation that has been introduced into our black rubber line. The Syntron vibrator screen shown carries the black from the reslurry or leach tank to the bite of a pair of squeeze rolls running at a surface friction of 1.5 to 1. The upper roll is not free-floating but is under pressure like a conventional rubber mill roll and is tightened down to a gauge of about 1/32-inch. Also shown in this figure is a felt-covered suction roll used to pick up loose water which has been wrung out of the rub-

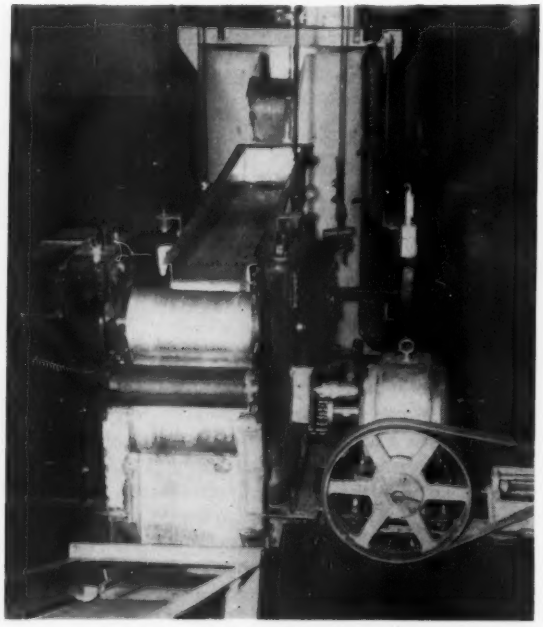

FIG. 4—Squeeze rolls, suction roll and belt take-off.

ber, but has gone through the bite of the rolls with the black rubber.

Passing the black rubber crumb through the squeeze rolls with the 1.5:1 friction ratio does three things:

(1) It wrings out a good part of the water remaining entrained in the crumb.

(2) It toughens the rubber sheet so that on passage through the Jeffrey hammer mill it forms flakes about fingernail size which do not pulverize in the stream of hot gas in the rotating drier.

(3) It takes the first step of forcing the carbon black into the rubber instead of leaving it distributed around and amongst the coagulated rubber latex particles. It thus accomplishes what was set out earlier as the ideal, viz., the dispersion of the black actually into the rubber at a temperature below gel-raising and elongation-reducing levels. It gives the rubber compounder the maximum latitude in stiffness, modulus and elongation control through time and temperature of processing in his own factory. In this squeezing or water wringing action the limits are the maximum pressure and friction ratio giving only a few degrees temperature rise above that of the feed to the rolls.

## Drum Drier for Black Rubber Flakes

From the squeeze rolls the black rubber in sheet form moves up the conveyer belt, shown both in Figures 4 and 3, where it is carried to the top floor

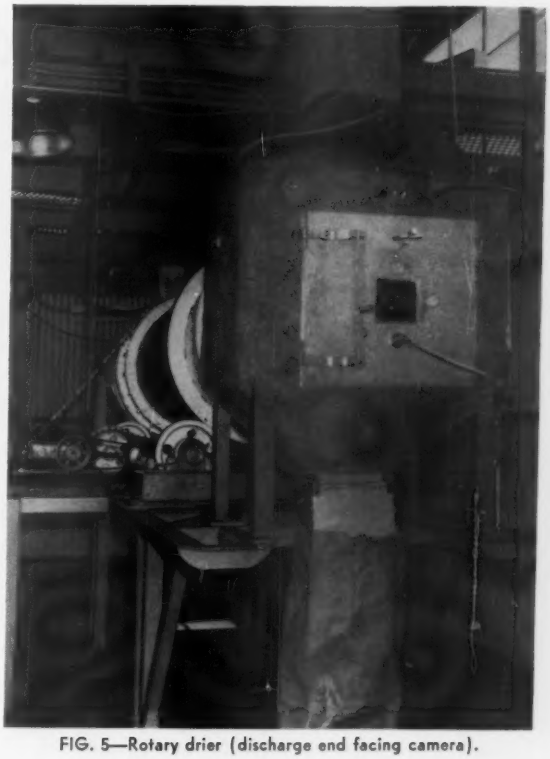

FIG. 5—Rotary drier (discharge end facing camera).

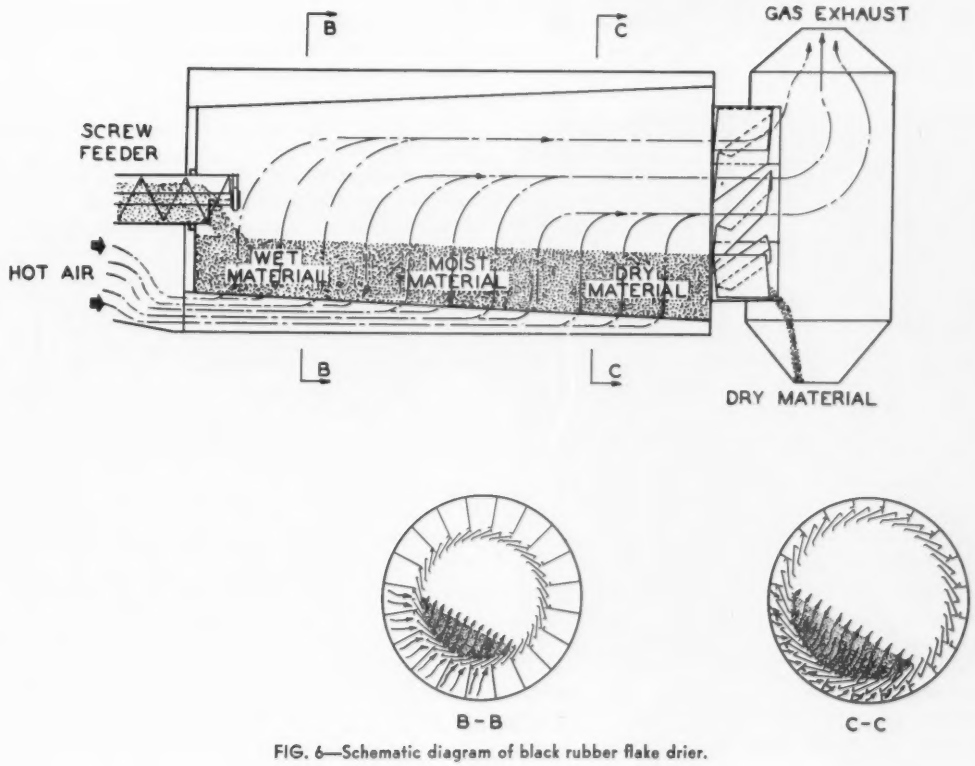


FIG. 6—Schematic diagram of black rubber flake drier.

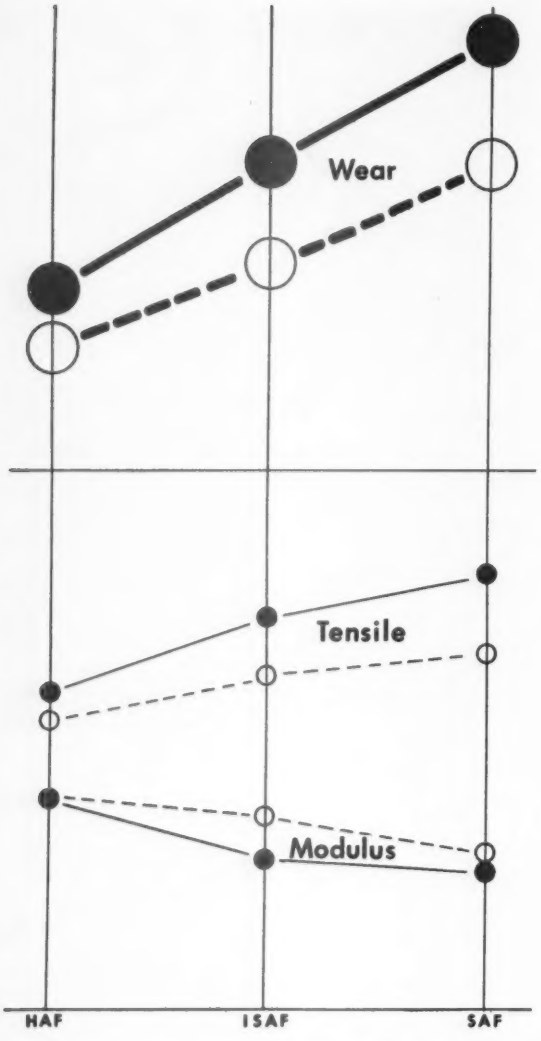


FIG. 7—Black rubber (dot) versus dry mix (circle) for tread carbons.

of the adjacent room, dropped into a Jeffrey hammer mill and finally into the rotary drier shown in Figure 5. The hot gas generator for this drier is mounted outside the building for the obvious reason of comfort. The hot gases generated are circulated through the drier by fans. This drum has an inside lining of stainless steel louvers which permit the hot gases to pass to the inside and float and dry the black rubber flakes in their passage through the drier. A diagrammatic sketch is shown in Figure 6.

Returning to Figure 3 we notice in the background the control panel from which the various stages of the operation are controlled. These include the motor switches; the manometers for oil, latex and slurry; the pH recording controller; variable speed controllers for the Syntron vibrators, and the temperature recording controller for the drying drum. Since our pilot plant is used for research and development work only, it is tuned up to operate at a capacity of about 200 pounds of black rubber per hour.

## Conclusions

The original concept of the Columbian black rubber process was tried out on laboratory scale equipment. As soon as it was recognized that carbon black in a straight water suspension could act as a creaming agent, it was decided to go to a continuous process. The prototype of this pilot unit was set up and developed to the point where the underlying principles were proved.

Much of the early work was repeated on this new unit with greater reproducibility than was originally the case and the broad story of improved reinforcement and tire wear is shown in Figure 7. Here the black rubber data are shown in solid black and the dry mix controls in hollow circles. The road wear data are plotted as very large circles in recognition of the experimental variation of road testing and to embrace the range of our own experience. The dry mix SAF represents the best we have been able to do with this carbon regardless of time and cost of processing. A wide range of percentage improvement via black rubber can be obtained depending on which black rubber is matched against which control. Four statements can, however, be made:

(1) Black rubber has consistently worn better than its own dry mixed control.

(2) In their respective black rubbers, the finer blacks have consistently worn better than the coarser ones.

(3) Very fine carbon blacks with reinforcing potential not attainable by dry mixing offer no problem in black rubber.

(4) The probable expectancy of improvement in going from HAF dry mix to SAF black rubber is in the range of 40%.

A black rubber drying process has been developed which starts the actual dispersion of the carbon black into the rubber. It takes advantage of the greater efficiency of a rotary drier system and avoids the snowballing effect frequently encountered in the past.

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# *Information on* Conveyor Belting used in Food Processing . . . *one of the most highly specialized segments of the rubber industry*

**By J. WALLACE ROWLAND, Jr.**

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ONE OF the most highly specialized segments of the rubber industry is the production of conveyor belting used in food processing. It is here that the manufacturer is confronted by a wide range of materials and conditions which are most conducive to the degradation of both fibers, elastomers, and resins. There is the action of oils, fats, sugars, salt, and other chemicals combined with physical conditions such as sub-zero to elevated temperatures, wet processing and the abrasiveness of the substance being conveyed. Too, the belting must be resistant to alkalies, detergents, steam and sanitizers which are applied to keep the surface sanitary.

The designer of the conveyor belts, in order to meet these broad requirements, is limited in the choice of compounding materials, since practically all food handling belting is pigmented white and should resist staining and discoloring. It is also essential that non-toxic agents be used exclusively. And naturally any which might affect the taste of the foods are eliminated (Figure 1). Even materials which might raise a doubt are excluded, although they in themselves are perfectly safe in this respect. For example, it is commonly known that water in many areas is carried through lead pipes with complete authorization and safety, yet a processor or consumer would hesitate if he knew that a lead compound had been used in the carrying surface of a food conveyor.

The toxicity of all items going into such a conveyor should be carefully checked to insure that nothing injurious to humans is present. Plasticizers are probably the chief concern in this regard, since some may be leached out of a rubber cover by the oils and water which are used to process many baked items, vegetables and meats. A recent amendment to the Federal Food, Drug and Cosmetic Act, cited as the "Food Additives Amendment of 1958," stresses this point of non-toxicity.

The purpose of this discussion is to present the basic steps and compositions which combined, lead to the production of food conveyor belting.

## Belt Construction

Solid woven belting is usually woven of cotton yarns which are impregnated and provided with an outer cover, or jacket, of an elastomer such as neoprene or nitrile rubber. Several important features are provided by this construction; namely, the elimination of ply separation and reduction of edge wear. The designation "solid woven" means that the plies are woven together, using innerbinding yarn to make a solid, or one-piece construction. The thickness range of such belting is 3/32 to 1/2-inch, with a tensile of up to 2700 pounds per inch width (Figure 2).

Good resistance to edge wear is developed since all belting has rounded woven edges. Rolls of belting to fit all width conveyors up to 96-inches wide are woven on heavy looms and provide this feature.

In order to present a surface which is impervious an impregnation treatment is given the belting usually followed by the application of a coating. Sometimes only a smooth cover or casing is necessary to keep the belt free from penetration of food ingredients, oils and moisture.

Most suitable for belt impregnations are solvent

FIG. 1—The designer of conveyor belts used in food processing operations must meet many requirements, among which is that the food must not come in touch with any toxic or taste-influencing agents. Above, cookies are transported on a nitrile rubber belt.

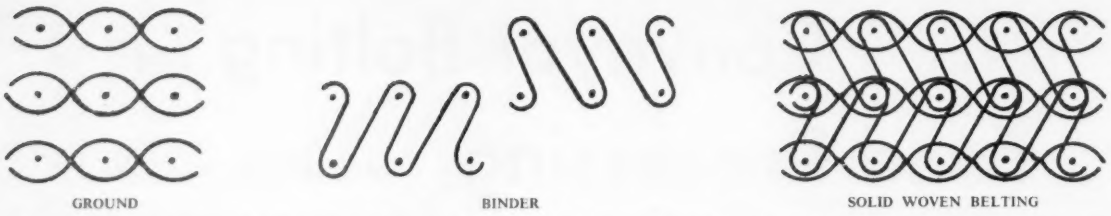


FIG. 2—Schematic diagram of a three-ply solid woven belting showing how ground and binders are integrated to form the construction.

cements of neoprene and nitrile rubber. The degree and quantity of penetration of the synthetic rubber into the carcass depends chiefly on the factors of time of immersion in the cement, its viscosity, and solids content. Solvent characteristics also contribute to the efficiency and speed of penetration.

Cements with solids up to 30 per cent are permitted to soak into the belting in large impregnating tanks. The belting is slowly and continuously passed through these tanks so that as the exit end is reached, it has been thoroughly saturated with the solution. The speed of travel through any one tank is dependent on the thickness and woven construction of the belting.

As the belt comes out of the impregnating tank the excess cement is scraped off, the belt continuing to a vertical radiant heat dryer to evaporate the solvent. In some instances this treatment is repeated to increase the amount of deposited rubber.

After impregnating and drying, a pass is made through a dipping trough where a heavier coating cement compound is applied. Drying again follows, but here a horizontal oven is used. This dryer, which may be as long as 100 feet, is usually a steam or electrically heated forced convection type. Temperatures inside the dryer are in the 175° to 250°F. range, depending on the solvent system in a particular cement. This means of drying utilizes a controlled flexible heating medium which is directed counter to the direction of the belt travel and in proportion to the amount of heat transfer required to drive out the solvents. To prevent too rapid initial drying and subsequent skinning over and blistering of deposited film, the dryer should be designed with the cooler end being the one the belt enters.

There are two types of vulcanizing methods most commonly used. The principal one is by press curing, where pressures up to 200 pounds per square inch are applied in conjunction with temperatures as high as 325°F. (Figure 3). It is here that most of the stretch in a belt is removed by applying tension, making an elongation of up to 5 per cent in the pressed length.

Since there are no plies to separate through the formation of blisters inside the carcass, the press may be opened hot, making it unnecessary to cool the platens to prevent the spread of blistering which might otherwise occur when the pressure is released.

The other vulcanizing method consists of sending the belt through a steam-heated oven using heat alone in the process. This is chiefly used where a smooth pressed surface is not desired or after fabric cleats, which have been attached and coated with cement, are to be cured.

Impregnated belts are sometimes provided with a top cover of a vinyl copolymer in plastisol form. The plastisol is fused to the surface by passing the coated belt through an oven supplied with steam or radiant

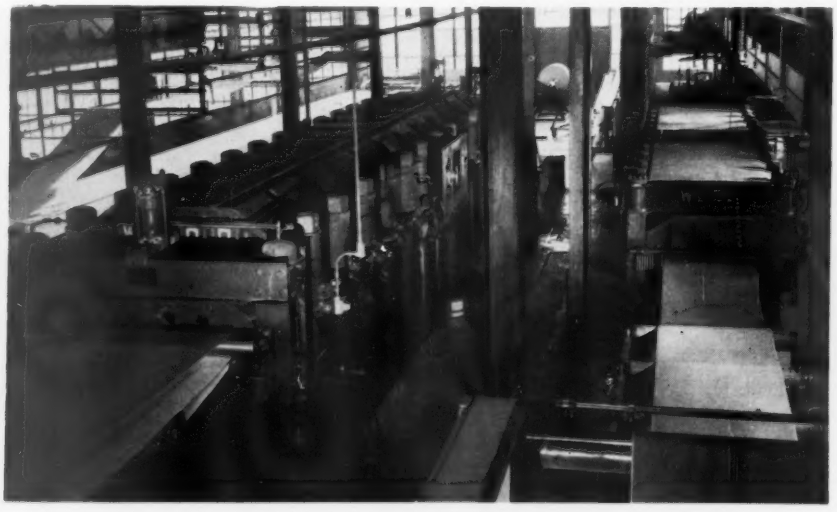

FIG. 3—Vulcanization of food conveyor belting: on the left, solid woven, and on the right, laminated style.

heat. Temperatures are of the range 350° to 400°F. A tough, smooth cover is applied by this means.

Solid woven belting is also impregnated with wax-blends for conveying bagged and packaged merchandise. Here hot, melted waxes and plasticizers are contained in a vat with the belting being run through and then out between light squeeze rolls. Running the full length of the belt onto cooling and "stretching" frames permits the development of the features of this treatment (Figure 4).

Nitrocellulose and vinyl surface coatings which consist of nontoxic cements or solutions knife coated on one or both sides are also used. Solid woven belting is also used in the untreated state, where contamination of the belting is not a problem.

## Friction or Laminated Construction

Friction or laminated belting for conveying food is similar to flat belting designed for other conveying work with two exceptions: (1) It is used for lighter loads on smaller pulleys and (2) It is resistant to a broad field of chemical as well as physical media.

Plies usually consist of cotton duck in the 15 to 32 ounce per square yard range. Sometimes only a single ply is used but most of the belting is made of two to four plies.

Newer developments have brought into use plies of cotton with a filling of nylon or rayon. Another construction utilizes filament rayon in the warp and spun rayon as a filling. Where maximum resistance to oils and heat is required, all dacron ducks find application, providing the cost is not a limiting factor. In cases of this kind, nitrile rubber is generally the elastomer used to friction the plies together and provide the cover.

Cotton duck is by far the universal fiber for food belting, due largely to its dimensional stability in both processing and use, good chemical and physical resistance and low cost. While other fibers may be used which will provide greater tensile on a unit basis, this property is often superseded by the need of a thicker belt to provide crosswise stability to the conveyed products and strength in butting the ends together with fasteners (or laps where endless belts are used). Then, too, a thinner constructed belt which utilizes a fiber stronger than cotton is more vulnerable to loss through accidental cutting or other damage when in operation.

## Impregnation of Duck

The plies going into the carcass are prepared for lamination by using a dip trough to impregnate them. Solvent cements of neoprene or nitrile rubber are the most suitable, taking end results into consideration. Impregnating the plies offers certain advantages:

(1) The individual fibers are surrounded with a film of the elastomer which cushions them as they flex against each other, providing longer flex life.

(2) The belt carcass has greater water and oil resistance.

(3) Wicking of water and oil from exposed edges or cover cuts which may be incurred on the job is kept to a minimum.

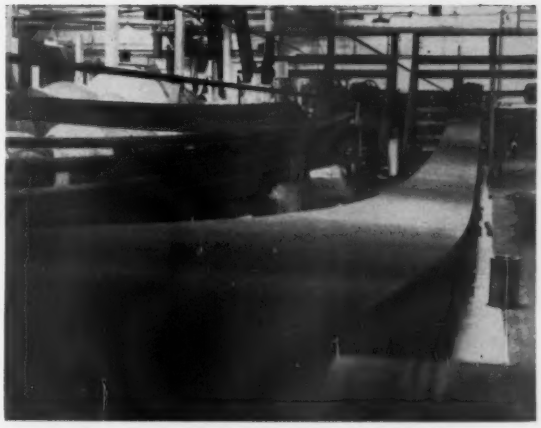

FIG. 4—A resin-wax impregnated solid woven belting on a stretching frame, where it undergoes a "seasoning" operation.

(4) Belt ducks of man-made spun fillings with filament warps do not require a special primer to obtain good adhesion between plies.

The speed of the duck through the cement varies from 6 to 10 feet a minute, with a heavy coat being permitted to remain on the top side. This induces further penetration into the yarn as the duck travels toward the dryer. For duck which is difficult to penetrate, a pre-dry, through a hot air box removing moisture present in the yarn, is customary. Pre-drying also precludes the possibility of blisters developing in the press vulcanizing operation from any trapped moisture in the cotton plies.

The dipping procedure is then repeated to build up a suitable friction coating of elastomer on the surface of each ply. The dryer is of a horizontal forced-hot-air type, described above in relation to solid woven belting.

## Neoprene and Nitrile Rubber Cements

Neoprene has long been used as a non-toxic, oil resistant impregnation and cover for food belting. For general purpose handling of foodstuffs, it is the best elastomer available for cement impregnation applications. Solvent cements made of this polymer which have long shelf life can readily be formulated to meet the requirements of food processing. When toluene is used as the solvent, penetration into solid woven belting or belt duck is excellent. The same is true when aliphatic diluents or extenders are used with the toluene.

Another feature of neoprene is that it can be compounded to produce surfaces which impart no odor or taste to the raw or cooked food, as seen in Figure 5. Also, excellent adhesion between plies is obtained, and this is especially important since practically all food handling belts are required to be pigmented white, precluding the use of carbon blacks as tensile builders.

During the past five years the use of nitrile rubber has found increased application in the manufacture of food conveyor belting. This is primarily due to its excellent resistance to the various vegetable and animal

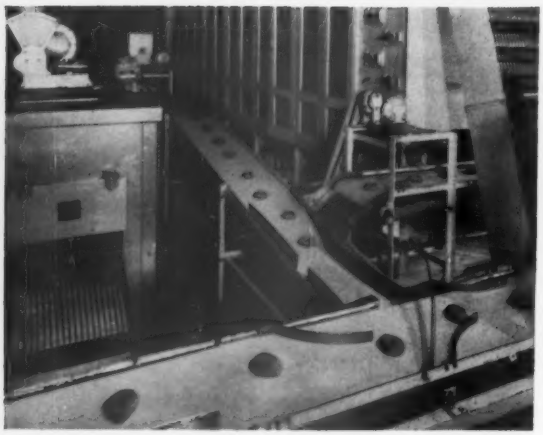

FIG. 5—A neoprene-cotton laminated belting carries hot doughnuts from a cooker without imparting odor or taste to the food.

oils and fats used in the food industry. At the same time good heat resistance can be compounded into the elastomer. These two features are of great importance, as many processing installations are going to increasingly higher temperatures where oily conditions are present. Nitrile rubber also offers odorless and non-toxic compounds which along with a solvent are readily churned into cements giving good shelf life.

One of the better features of the white covers made from this elastomer is their resistance to discoloring from sunlight and, to a lesser degree, from heat. In addition, nitrile rubber can be blended with vinyl resins to give outstanding abrasion resistance, and at the same time ozone resistance is improved. Adhesion of plies is adequate with a peel strength of 22 pounds per inch width being common. The cookie conveyor shown in Figure 1 utilizes nitrile rubber.

In making friction or laminated belting the impregnated and coated plies of fabric are assembled one on top of the other with a uniform tension, on an assembly table. These fabrications are then passed through a calender, forcing out entrapped air and setting the plies in place under a given tension.

Coming from the calender the belts are either dusted and press vulcanized, or left undusted, with a cover sheet being applied to the top surface as entry into a press is made. Press curing is carried out using temperatures of 287° to 325°F. (Figure 3).

Belting of this construction is most economically produced in wide widths, 60-inches or wider being average, and up to 1,000 feet in length. As individual belts are cut from these rolls, the exposed edges are given a coating of a tough edge sealant, to augment the protection of the impregnation.

## Conclusion

With the development of new processes and the increasing popularity of packaged and canned fruits and juices, vegetables, meats and baked goods, the food processing industry has a bright future. All of these products are carried, at various stages of preparation, on conveyor belting. They are conveyed directly on belts in the raw, precooked and frozen state as well as in the final packaged or canned form. Belting must be continuously designed to meet the ever increasing demands of production, processing and sanitation made by this growing industry.


## Coming Next Month...

**Constitution and Variability of Rubber from Individual Trees—By A. R. Kemp, Research Associate, University of Southern California, Los Angeles, Calif.**

Findings from studies in Florida and Costa Rica on how the rubber from one tree differs from that of its neighbor.

**Evaluating Flexible Foam Materials—By L. A. Rosenthal and G. I. Addis, Development Laboratories, Union Carbide Plastics Co., Bound Brook, N. J.**

Description of an instrument which makes possible study in greater detail of the impact properties of flexible foam materials.

**Determining the Bound Styrene in Styrene-Butadiene Copolymers—By C. L. Hilton, Research Center, U. S. Rubber Co., Wayne, N. J.**

Description of a streamlined method involving nitration and spectrophotometric analysis.

**European Report: England—By James B. Braden, United Carbon Co., Inc., Akron, Ohio**

The first of a series of four articles on the rubber industry in Europe analyzes the situation in Great Britain.

Plus R/A Special Industry Report

**Airplanes in the Rubber Industry**

How a new industry tool is helping the rubber manufacturer.

EFFECTS OF

# OZONE on RUBBER

***Condensed versions, specially prepared by the authors, of papers presented at the May meeting of the Rubber Division, ACS***

ONE OF the highlights of the May meeting of the Rubber Division, ACS, in Los Angeles, was a symposium on the "Effects of Ozone on Rubber." The information which the speakers presented was of such high caliber and widespread interest that RUBBER AGE approached the authors to see if they would prepare condensed versions of their addresses for its readers. Their cooperation, for which the editors wish to express sincere thanks, has been outstanding, and the special versions of the majority of the papers are presented herewith. The six invited papers at the symposium, including two for which condensed versions were not available, are scheduled for full publication in a forthcoming issue of *Rubber Chemistry and Technology*. Also unavailable were condensations of three other of the papers.

## Ozone Cracking of Rubber in the Los Angeles Area

**By A. J. HAAGEN-SMIT,** *California Institute of Technology, Pasadena, Calif.,*
**M. F. BRUNNELLE,** *Los Angeles County Air Pollution Control District, Los Angeles, Calif.,*
**and J. W. HAAGEN-SMIT,** *A. O. Beckman, Inc., South Pasadena, Calif.*

INVESTIGATIONS on the smog conditions in Los Angeles have substantiated claims of rapid deterioration of rubber goods in this area. The damage is characterized by sharp cracks which may penetrate deeply, causing serious failure. These cuts appear only when the rubber is under tension, and cross the lines of tension at an angle of 90°. This cracking is typical for the action of ozone, and subsequent research has shown that ozone is actually present in unusually high concentration whenever smog attacks occur.

It has been established that these abnormally high ozone concentrations, 10 to 20 times higher than normal for country air, are formed in a reaction in which the sunlight plays an important role. The reactants in this photochemical process are oxides of nitrogen and hydrocarbons, as shown in previous publications.

The organic material is emitted in the Los Angeles basin by nearly three million motor vehicles, which contribute the major part of the total daily emission of 1500 tons. Of this total, production, refining and marketing of petroleum products account for some 300 to 400 tons. In the combustion of all kinds of fuel —oil and gas, as well as gasoline—700 tons of oxides of nitrogen are produced daily. We estimate that through the reaction of these materials 600 tons of ozone is present in the atmosphere of Los Angeles on a smog day, frequently giving rise to concentrations as high as 50 parts per hundred million.

The presence of ozone can be followed by exposing standardized bent rubber strips to the atmosphere and measuring the number of cracks and the crack depth. The degree of cracking shows a daily variation with an optimum during the daytime, and is higher during the summer months, in harmony with the photochemical origin of the ozone. Chemical measurements of the oxidizing power of the atmosphere show a similar trend.

Results obtained over a three year test period are presented, as well as a comparison with oxidant and ozone values measured in the same area.

Simultaneous measurement of the cumulative rubber cracking in Wethersfield, Conn., and in Pasadena from January-December, 1956 has shown significantly lower values in Wethersfield throughout the year. The low values obtained in Wethersfield during the colder months can be attributed to temperature effects. However, even during the summer months the cracking was 40 per cent more severe in Pasadena, verifying the complaints of rubber manufacturers regarding the rapid deterioration of their products in this area. However, oxidant smog is becoming increasingly prevalent in other areas, and unusually high oxidant values have been reported in San Francisco and San Diego on the Pacific Coast, and in the vicinity of Washington, D. C., as well as in other localities.

The cumulative rubber test is useful in the correct interpretation of outdoor exposure tests of rubber goods, since it integrates the variable action of ozone due to large fluctuations in its concentration and the reaction rate, which is affected by climatological factors. This test has provided valuable information when used in conjunction with long term exposure tests of rubber articles conducted by the Armed Forces.

When temperature and flow rate of the air are kept constant, the test offers an inexpensive and convenient way of area surveys in air pollution studies.

EFFECTS OF OZONE ON RUBBER

# Ozone Resistance of Styrene-Butadiene Rubber at Low Temperatures

By R. F. GROSSMAN and A. C. BLUESTEIN
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STYRENE-BUTADIENE rubber has found increasing use in low temperature service applications, where ozone resistance becomes critical if continuous outdoor exposure is envisioned. Experimental data on the effect of low temperature on ozone resistance of elastomers has been rather sparse. Kearsley, in 1931, noted that natural rubber when "frozen" was not cracked by ozone and a study by Ball et al showed that, at elongations below 50%, natural rubber showed no cracks in the presence of substantial ozone below –180°C. Recently, the ozone resistance of styrene rubber has been shown to be unexpectedly high at –48°F.

In the present study, a black-filled, plasticized styrene rubber compound, suitable for low temperature service, was prepared and subjected to 0.025% ozone at various temperatures. Dumbbell samples were stretched and allowed to relax at the test temperature before being exposed to ozone.

The results are reported in the accompanying table. Ozone failure time is taken as the time required for the first visible crack to appear. At room temperature, samples are cracked so rapidly that the expected dependence of failure time upon applied stress is obscured. At elongations of 150% or greater, the dependence of failure time upon temperature appears to follow simple kinetic considerations, increasing slowly with decreasing temperature. This was to be expected, deriving from the probable low energy of activation required for the addition of ozone to unsaturated linkages. At extreme elongation, temperature dependence becomes obscured, again by the rapidity of cracking.

In view of the above results, the behavior of samples at low elongation is surprising. At elongations of 100% or less, decreasing temperature results in a discontinuous rise in ozone resistance. Only in the case of measurements made at –60°C. were the samples at or near the brittle point of the compound (as determined by TR 10 values). In the tests at temperatures above –60°C. no substantial glassification, or, of course, crystallization, was evident. These observations render unsatisfactory the hypothesis that increased ozone resistance has resulted, in this instance, from strain removal by immobilization.

Kinetic studies of ozonolyses in the literature indicate that the rate determining step is the initial ozone addition to the double bond, and that this step proceeds by a first order process with respect to ozone. In an early study, infrared analysis of ozonized natural rubber and other elastomers failed to disclose any ozonide formation, only decomposition products being noted. Recently, however, Kendall and Mann have correlated the infrared spectra of natural and acrylonitrile-butadiene rubber ozonides with those of simple ozonides, clearly establishing the existence of the former. Decomposition products were noted early in the ozone-rubber reaction, suggesting that carbon-carbon scission at double bonds occurred simultaneously with ozonide formation. These results suggest the room temperature instability of rubber ozonides, a conclusion readily transferable to the case of styrene rubber.

The reaction of ozone with the carbon-carbon double bond is generally viewed as involving a simple primary adduct capable of rearrangement to the classical ozonide. This process involves an instability to strain, leading to a microscopic crack. The present study indicates that styrene rubber ozonide is subject to a thermal as well as a strain instability.

Analysis of the effects of strain and temperature shows that at elongations of 150% or greater, the ozonide instability derived from strain is sufficient to crack the sample at any temperature above the glassification point. The stabilizing effect of low temperature appears at about –20°C. in the case of elongations of 25% or lower. At such elongations, reduction of the temperature to –40°C. results in more or less complete protection from ozone, under the conditions employed. As the strain is increased, lower temperatures are required.

As the sample passes from the area of temperature and strain of rapid ozone cracking, to the area where cracking occurs slowly or not at all, the rate determining step shifts from addition to the double bond to the decomposition or lack of formation of the ozonide. The results are evident. Styrene rubber vulcanizates under Arctic conditions, –20 to –60°C., should acquire increased ozone resistance from the increased ozonide stability encountered. On the other hand, the shift from ozone addition to ozonide decomposition as the rate determining step suggests that the effectiveness of antiozonants will be decreased as the transition temperature, at the strain involved, is reached.

OZONE FAILURE TIME*

| Temp., °C. | % Elongation 25 | 50 | 100 | 150 | 200 | 300 |
|---|---|---|---|---|---|---|
| 20 | 2 | 2 | 1½ | 1 | 1 | 1 |
| 0 | 5 | 4 | 2 | 1½ | 1 | 1 |
| –20 | 37 | 14 | 4½ | 2 | 1 | 1 |
| –40 | OK | OK | 7 | 2½ | 1½ | 1 |
| –50 | OK | OK | 18 | 3½ | 2 | 1 |
| –60 | OK | OK | OK | 5 | 2½ | 1½ |

*Figures indicate minutes to first visible crack; OK indicates no crack after six hours.

# A Method of Screening Antiozonants

By F. A. V. SULLIVAN and A. R. DAVIS

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EFFECTS OF OZONE ON RUBBER

A METHOD has been developed to screen organic compounds prior to testing them as antiozonants. The only method of its kind known to separate those compounds that should be tested in rubber from those that should not is based upon the ability of a compound to suppress the reaction of ozone with the model unsaturated hydrocarbon, cyclohexene.

The value of an organic compound as an antiozonant in rubber can only be determined by testing the compound in a rubber recipe under conditions to be met in service. For a compound to be a good antiozonant in rubber, it must prevent the reaction of ozone with the unsaturated hydrocarbons in rubber. This condition is the basis of the new screening procedure. Other available methods determine the ability of a compound to react with ozone alone.

Chemically, the method is based upon two well-known reactions of ozone—the one-atom and three-atom reactions. In the one-atom reaction, one atom of oxygen in the ozone molecule is consumed. The other two atoms combine to form a molecule of oxygen.

Potassium iodide, for example, reacts completely and rapidly with ozone in the one-atom manner:

$$2KI + O_3 + H_2O \rightarrow I_2 + O_2 + 2KOH \qquad (1)$$

This reaction has been fully investigated and is the accepted analytical procedure for the determination of ozone (C. E. Thorp, "Bibliography of Ozone Technology," Vol. 1, pp. 38-58).

Effluent streams from KI-scrubbed ozonized air show a decrease in oxygen content equal to one-third of the oxygen of the air stream converted to ozone by the ozonator:

$$\text{Ozonator: } [3O_2] \rightarrow 2O_3 \qquad (2)$$

$$\text{KI Solution: } 4KI + 2O_3 + 2H_2O \rightarrow 2I_2 + 2O_2 + 4KOH \qquad (3)$$

Substituting oxygen equivalent to ozone from equation (2):

$$4KI + [3O_2] + 2H_2O \rightarrow 2I_2 + 2O_2 + 4KOH \qquad (4)$$

This reaction is truly representative of the oxidative reaction of ozone, which may be designated as the one-atom reaction.

The reaction of ozone with unsaturated hydrocarbons has been accepted as representative of the three-atom reaction of ozone, in which three atoms of oxygen are consumed:

$$-C=C- + O_3 \rightarrow -C(-O-O-O)-C- \rightarrow$$

$$-C(-O-O)-C- \rightarrow \text{Ozonide Products}$$

After passing through an excess of an olefin, a stream of ozonized air should show a decrease in oxygen content equal to that of all the oxygen in the air stream converted to ozone by the ozonator. This is designated as the three-atom reaction.

If air containing 21% by volume of oxygen is converted by an ozonator to a stream containing 2% by volume ozone and 18% by volume oxygen, scrubbing this stream with KI results in an effluent containing 20% oxygen. Passing this same stream of ozonized air through an excess of a reactive olefin results in an effluent containing 18% by volume oxygen.

In our screening method, the test compound is dissolved in $CCl_4$ together with 50 equivalents of cyclohexene. The solution is placed in a reactor and chilled to 0°C. An air stream containing ca. 2% ozone by volume is passed through the solution at the rate of 140 ml. per minute ($1.34 \times 10^{-4}$ moles of $O_3$ per minute).

The effluent stream from the reactor is then passed through a KI scrubber to remove residual ozone and is dried in a $CaSO_4$-filled tower. Its oxygen content is recorded at ten-minute intervals alternately with that for the effluent from the KI-scrubbed ozonized stream. This effluent shows a progressive decrease in oxygen content. The peaks of the values fall on a straight or near-straight line.

The curve is extrapolated to zero time. This intercept at the oxygen ordinate is taken as the considered value of the compound.

In competing with a large excess of cyclohexene for the ozone in the stream, the compound is able to suppress the three-atom reaction by a value A expressed in per cent by volume of oxygen. The magnitude of this value may be taken as a means of evaluating compounds as potential antiozonants.

A known antiozonant may be selected whose value A is used as a reference standard. The accompanying table shows the duplicability of results for the determination of A for N,N'-dioctylparaphenylenediamine, the reference compound.

N,N'-DIOCTYLPARAPHENYLENEDIAMINE DECREASE PER CENT $O_2$ BY VOLUME

Experimental error: ± 0.02% by volume

| One-Atom Reaction | Three-Atom Reaction | Mixture | A |
|---|---|---|---|
| 0.88 | 2.64 | 1.30 | 1.34 |
| 0.92 | 2.76 | 1.40 | 1.36 |
| 0.94 | 2.82 | 1.47 | 1.35 |
| 0.92 | 2.76 | 1.42 | 1.34 |
| 0.94 | 2.82 | 1.48 | 1.34 |

EFFECTS OF OZONE ON RUBBER

# Correlation of Ozone Chamber and Outdoor Exposure

By H. A. WINKELMANN

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THIS study reports on outdoor exposures of styrene rubber samples started seven years ago in Chicago and elsewhere, and in the ozone chamber. A 50 hardness extruded styrene rubber was mixed in a No. 11 Banbury leaving out the sulfur and accelerator. These were later added on a laboratory mill. Antioxidants, antiozonants and other chemicals were also added with and without a protective wax. The wax was added in a molten condition. Each compound was extruded through a triangular die (ASTM D1170) and cured in 50 to 60-inch lengths in open steam for 20 minutes at 315°F. Test specimens ten inches long were used.

## Testing Procedure

For exposure tests, bench marks were placed on each specimen with crayon, 7½ inches apart (1¼ inch from each end). The specimen was formed into a loop by placing the ends together and tied securely with copper wire at the bench marks. The mounted specimens were rested for a minimum of 48 hours at room temperature before outdoor exposure. Ratings were made at frequent intervals using the following rating system:

0 No cracking visible at 2x magnification.
1 No cracking visible at 1x magnification, but visible at 2x magnification.
2 Small cracking visible at 1x magnification.
3 Medium-size (or larger) cracking.

Exposures of 1546 samples outdoors in Birmingham, Michigan for 30 days and of an equal number in the ozone chamber for 70 hours using 25 parts ozone per 100 million air were made. In the aggregate, these tests show good correlation. The 0 and 1 ratings correlate closely, while the ozone chamber shows a greater number of 2 ratings. Michigan produced 533 samples with a 3 rating as compared with 434 samples in the ozone chamber. It should be noted, however, that strips cut from one length of compound may show a rating of 0 in the ozone chamber and yet give ratings of 1, 2, or 3 on outdoor exposure. Conversely, the ozone chamber predicted poor weatheraging for samples which outdoor weatheraging in Michigan rated at 0. Thus, if the ozone chamber is taken as standard, the study shows that in Michigan its ratings are not duplicated.

Thirty-day exposures in Chicago were compared with 6 to 7-year exposures. Exposures in the ozone chamber for 70 hours at 100°F., using 25 parts ozone per 100 million of air, were also made. The 6 to 7-year exposures show a decrease in 0 ratings and an increase in 3 ratings. These exposures do not correlate with the ozone chamber tests. The thirty-day exposures conform closely to the ozone chamber exposures, though the ozone chamber gives a greater number of 2 and 3 ratings.

If we use the ozone chamber as a control, we can accurately follow the outdoor weatheraging of the samples. Again, there is a lack of correlation between samples cut from the same strip. For example, 746 samples gave a 0 rating in the ozone chamber. Outdoors these samples having ratings ranging over the entire scale of 0, 1, 2 and 3. The cracking for the 6 to 7-year exposure is more severe than for 30 days. Similar variations are noted among the other ratings of 1, 2 and 3 in the ozone chamber.

## A Major Cause of Ozone Cracking

One of the major causes of ozone cracking and poor weatheraging of molded rubber parts is poor mold surface finish. A smooth micro finish is important and necessary. The surface must be free of machine marks, grooves and cuts. These interfere with the flow of the stock over the surface of the mold. Even a chrome-plated finish over an ordinary polished surface is not good enough to insure good weatheraging. Mold surfaces must be kept clean because a dirty mold accelerates poor weatheraging.

Weatheraging failures in which no ozone cracking is observed are flow lines, flow cracks, flow line splits and poor knitting. These failures occur in the longitudinal direction and are not characterized by the transverse cracks which accompany ozone cracking. After prolonged exposure ozone cracking may occur, but this failure is secondary.

Flow cracks and poor knitting are caused by excessive lubrication, set-up stock and poorly polished mold surfaces. A surface set will prevent rubber surfaces from properly knitting together during molding. Flow cracks, poor knitting and related failures may show up on outdoor exposure after 30 to 60 days. Flow cracks were observed only once during exposure in the ozone chamber.

Poor dispersion as evidenced by pigment agglomerates is another cause of poor weatheraging. When the pigment agglomerates or foreign matter drops out, ozone cracking becomes evident.

On an extruded weatherstrip transverse ozone cracking and longitudinal splitting were observed in an ozone chamber. The longitudinal splitting was due to poor fusion of the stock through the die.

Such failures seldom show up in the ozone chamber. A sample that is satisfactory in the chamber may fail on outdoor exposure for these reasons other than ozone cracking. These observations are based on vulcanizates tested in Miami, Florida and Shapleigh, Maine.

# Comparative Performance of Antiozonants in Road and Accelerated Tests in the Los Angeles Area

By FRANK B. SMITH

*Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.*

EFFECTS OF OZONE ON RUBBER

IT IS a startling fact that the air we breathe, which sustains our very lives, is also capable of severely damaging the tires on our automobiles. The culprit is largely ozone together with oxygen which also causes rubber to deteriorate. The per cent of ozone in the air at Los Angeles is higher than in any other large city, and ozone cracking of tires is a serious problem there. For these reasons Los Angeles was selected over other areas as the site for testing antiozonants in tires.

It has been shown in a previously published report on this work that antiozonants are effective against normal atmospheric concentrations of ozone in the absence of wax although in accelerated tests in ozone boxes the degree of effectivenes of chemical ozone cracking inhibitors is largely masked. Also, dynamic outdoor cracking tests appear to correlate well with actual product tests made on tires. An outdoor weathering wheel is used for the tire tests. It was developed for accurate accelerated evaluations of chemical antiozonant protection. Weathering wheel tests correlate well with actual road tests indicating high validity for these results. In contrast, accelerated ozone tests, unless used in conjunction with the more definitive tests, are often invalid.

The present report is a continuation of the earlier work with added emphasis placed on actual tire performance and tire cracking problems generally. The degree of ozone cracking in tires can be materially reduced through the use of chemical antiozonants. Data presented show the relative effectiveness of several commercial antiozonants as determined on the captive wheel set up at Los Angeles. The tires were tested continuously, day and night; and trained technicians examined the tires every day. Comparative tires were also road-tested in Los Angeles.

In both cases the data show similar comparative ratings of antiozonant performance. Tires containing the chemical N,-isopropyl-N,′ phenyl-p-phenylene diamine (Flexzone 3-C, Naugatuck Chemical) as chemical antiozonant showed virtually no ozone checking at Los Angeles. The degree of protection afforded by several other ozone cracking inhibitors was insufficient to maintain as crack-free a condition as found with N,-isopropyl-N,′ phenyl-p-phenylene diamine. All of this testing was done in sidewall compounds using the antiozonants in combination with Sunproof Improved Wax. Multiple section passenger tires were used in this work.

Truck tires may develop bad ozone cracking when the trucks are driven with heavy loads for long periods of time at high speeds. The worst variety of cracking, known as groove cracking, may also develop under such service conditions. Groove cracking is capable of causing tire failure long before the tread is worn out. Nylon truck tires have been quite susceptible to groove cracking, and special processes are used by tire manufacturers in an effort to overcome this problem.

Truck tire tests were conducted in the laboratory and on the road in Los Angeles using N,-isopropyl-N,′ phenyl-p-phenylene diamine to eliminate flex cracking and groove cracking. Nylon truck tires (10.00-20 size) protected with 2.0 parts of N,-isopropyl-N,′ phenyl-p-phenylene diamine showed a 440% improvement in groove cracking resistance in road tests at Los Angeles. These tests were verified in truck tire tests made in Texas and in the Midwest. The data show that this chemical is uniquely effective for retarding groove cracking in truck tires. None of the other chemicals which were tested can be considered to perform this unique function of inhibiting groove cracking in truck tires.

The dual protective value of N,-isopropyl-N,′ phenyl-p-phenylene diamine will be useful in extending the service life of passenger and truck tires.

Set-up used in the captive wheel test in Los Angeles to test the effectiveness of commercial antiozonants in tires.

EFFECTS OF OZONE ON RUBBER

# Resistance of Rubber Compounds to Outdoor and Accelerated Ozone Attack: II

By G. N. VACCA, G. H. BEBBINGTON and R. E. JOHNSON
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IT WAS felt that a more comprehensive study of the protection of natural rubber against ozone attack than that reported in a first paper should be made. For this study, a tire tread type formulation was chosen. The plan was to study the effect of various protective agents on the static ozone resistance of the rubber stock. Protective agents included waxes, antiozonants and antioxidants. Each wax or chemical was tried in 1.5 and 3 phr concentration and one wax, Sunproof Super, was used in combination with the chemicals. The combinations consisted of 1.5 phr of the wax with 1.5 phr of the chemical and 3 phr of the wax with 3 phr of the chemical.

The waxes and the chemicals used are listed below:

Antiozonants and Antioxidants

| | | |
|---|---|---|
| Akroflex CD | Eastozone 32 | Monsanto CP20856 |
| BLE Powder | UOP 88 | Goodyear C 2X 1000 |
| Lanair 115 | UOP 288 | Wingstay S |
| AgeRite Resin D | UOP 1313 | Wingstay 100 |
| Neozone A | Santoflex AW | Flexzone 6H |
| Eastozone 30 | Santoflex GP | Flexzone 3C |
| Eastozone 31 | Monsanto CP20408 | J.Z.F. |
| | Monsanto CP20855 | |

Waxes

| | | |
|---|---|---|
| AA1177 | Sunproof Improved | Stanwax No. 1 |
| Acrawax C2 | Sunproof Super | Sunolite 127 |
| Advawax 290 | Heliozone | Detero 2200 |
| Cerise Brown | Herron | Detero 2250 |
| Sunolite 240 | Paraffin | Detero 2770 |
| Sunproof | | Sunwax 4415 |

It should be noted that the base stock contains 1.5 phr of AgeRite Resin D and that it is present in this amount in all of the test stocks.

The method of rating specimens follows that described in the first paper. Cracks visible to the naked eye are rated as failures.

## Results to Date

*Waxes 1.5 phr.* Ozone Chamber: All specimens showed cracking in one to four days.

Outdoors in Los Angeles: All specimens except those containing Cerise Brown Wax and Sunproof Super showed cracks after three weeks when the first observation was made. The bent loop specimen containing Sunproof Super had cracked sometime between the three week and six month reading.

*Waxes 3 phr.* While AA1177, Herron and Detero Wax 2770 gave marked protection, especially outdoors, only Cerise Brown Wax and Sunproof Super provided complete protection for six months in both exposures.

*Antiozonants and Antioxidants.* 1.5 phr: All specimens failed in one to seven days in the ozone chamber and in three weeks in Los Angeles.

3 phr: All specimens except Santoflex AW failed in one to seven days in the ozone chamber. In the case of Santoflex AW, the 30% stretch sample survived three weeks. In Los Angeles all the specimens showed cracks in two months except the 30% stretch specimen containing Eastozone 31 and the bent loop specimen containing UOP88. These remain uncracked after six months.

*1.5 phr Sunproof Super plus 1.5 phr Chemical.* This appears to be borderline protection and not very reliable. Correlation between the ozone chamber and outdoors is only fair. Judging by outdoor exposures, only the combinations containing Monsanto CP 20408, Wingstay S, Wingstay 100 and possibly the Flexzones 6H and 3C appear promising. The exposure on the Flexzones has run only two months.

*Antiozonants or Antioxidants 3 phr plus 3 phr Sunproof Super.* Some cracking was found in the ozone chamber but in view of the performance outdoors of 3 phr Sunproof Super alone, no cracking would be expected and none was found. Outdoor exposures will be continued and differences may be found at a later date.

Results obtained on synthetic isoprene rubber indicate that this polymer acts about the same as natural rubber.

## Conclusions

Crabtree has recommended that accelerated ozone tests on natural rubber be made at 100°F. In this study the test was conducted at 120°F. in order to gain greater acceleration. Where protection is poor, the accelerated test correlates well with the outdoor test. Where protection is marginal as in the case of 1.5 phr wax and 1.5 phr chemical, correlation is not quite as good but indications are that it will improve as outdoor exposure continues. Where protection is good as in the higher concentrations of wax and chemical, correlation again appears good.

The results of this work indicate that natural rubber can be made appreciably resistant to attack by ozone by the addition of 3 phr wax or 3 phr of some antiozonants. However, a much higher order of protection is obtained when 3 phr of wax are used in conjunction with 3 phr of antiozonant or antioxidant.

Many of the test stocks containing 3 phr wax, 1.5 phr wax plus chemical, or 3 phr wax plus chemical show excessive bloom. However, combinations of 3 phr wax with 3 phr AgeRite Resin D, Eastozone 30, UOP-88, UOP-288, UOP-1313, JZF and CP-20408 show only moderate bloom.

# The Operation of Ozone Chambers in Rubber Laboratories to Minimize Variations in Test Results

EFFECTS OF OZONE ON RUBBER

By H. LOWMAN

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MANY rubber laboratories have ozone test cabinets. Efforts to secure reproducible results between laboratories frequently resulted in wide discrepancies. This fact was confirmed and recognized by Section IV of SAE - ASTM and cooperative work in the member laboratories in the last 11 years has greatly reduced the variations. This article reports the results of that work, composed of static tests only of such nature as to have maximum technical usefulness as opposed to the research type of test.

An ozone cabinet, to properly be used in an ozone test must:

(1) Be capable of producing a definite percentage of ozone, and have a method for measuring the ozone concentration.

(2) Have means of measuring and maintaining the desired temperature.

(3) Possess a flow of fresh ozonized air through the chamber properly baffled to thoroughly circulate the box. The flow must be sufficient to change the air in the chamber every 1 minute 20 seconds or oftener at a uniform rate.

The discovery of the need for the high rate of flow of fresh ozonized air through the chamber was one of the major breakthroughs of the program to reduce variations in test results. A 1958 round robin incorporated this increased air flow and shows good agreement between laboratories.

Many types of test specimens have been used. The basic reason for any particular design of a test specimen is to permit the application of uniform or varying tension strain on the specimen.

The specimens fall into two classes, those with or without sharp edges under tensile strain. As Cox has shown, sharp edges under tension strain ozone crack much more readily than flat surfaces.

Since it is good design practice to avoid sharp edges under tensile strains, an ozone test specimen with no sharp edges under tension was desired. The triangular cross section specimen of D1171 used in this work was desirable since it had a radius at the apex which was under maximum tensile strain (28%).

Wood mandrels properly coated with spar varnish, aluminum mandrels, and glass mandrels can be used. Enameled copper wire or aluminum wire should be used for tying.

The effect of the time between mixing, preparation, and curing was thoroughly investigated. The conclusions were that the time between mixing and preparation and the time between preparation and molding had no effect on ozone resistance. If care is taken to prevent strains in the tubing, the time between tubing and open steam vulcanization apparently does not affect the ozone test result.

One should not expect the same ozone resistance with a compound vulcanized or molded in a different manner. No comparison should be made of different states of cure necessarily expecting identical results.

To minimize variation in test results in ozone testing, it is necessary to permit the sample to stand looped on the mandrels for 48 to 72 hours before placing in the ozone cabinet. Naturally, this rest period should be in a relatively ozone free atmosphere. Suspending the mandrel in a paper carton is satisfactory. The sample should not be looped on or off the mandrels for long periods of time or the results will be much less cracking.

The surface of the test sample should not be touched between the start of the preconditioning period and the end of the test.

The humidity in our work was recorded but not controlled. No correlation was found between ozone ratings and humidity. It appears that humidity has very little effect on the severity of ozone attack.

To evaluate the degree of ozone attack, most investigators have used visual methods of examination. It was used in these investigations. The ratings were the same as the present D1171, using a magnification of 2X.

The proper magnification has been the subject of considerable differences of opinion. From a practical viewpoint, it is difficult to see how a crack which is not visible under a 2X magnification will cause any serious weakness of a product.

The question arises, from the cracks observed, should the number of cracks in a specified area be used as a criterion? Or the size of the cracks?

The SAE - ASTM committee approached the problem from a strictly practical standpoint. If ozone cracks were to cause a failure of the part to function properly, a few cracks could cause the same failure as many cracks. The size of the cracks was therefore established as the sole criterion of the gradings of 0, 1, 2, and 3 in D1171. All specimens are examined at 2X. To minimize variations, the pictures must be used as the smallest cracks for the labeled grade.

To test the ability to reproduce gradings, a completely blind test was set up with 60 samples. These were rated by the writer and held for three weeks and again rated in a completely blind check. There was a 91% reproducibility of gradings.

The ozone concentration is most frequently analyzed iodimetrically. The analysis itself has been covered in the literature.

EFFECTS OF OZONE ON RUBBER

# Weather Aging of Elastomers on Military Vehicles

By W. D. ENGLAND, J. A. KRIMIAN and R. H. HEINRICH
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THE Ordnance Tank-Automotive Command, faced with the reports of field failures of rubber parts, turned to antiozonant development for a solution to the deterioration of tank and automotive end-items. A series of contracts were let with Burke Research Co. to find a feasible production antiozonant for styrene rubber items. End-item development contracts were let with Mansfield Tire and Rubber Co., Cooper Tire and Rubber Co., Denman Manufacturing Co. and Firestone Tire and Rubber Co. to develop the technology of building ozone-resistant tires. Similar contracts, including both tire and automotive mechanical rubber goods, were let with Lee Rubber and Tire Corp., and Dayton Rubber Co. The results were coordinated with industry and with tire advisory committees.

While work was going on to develop an antiozonant additive for current production, considerable effort was also concentrated on the preservation of tires, already in storage, by application of protective coatings.

## Ozone Exposure Tests at Pasadena

Information available indicated that the Los Angeles, California basin had the worst ozone environment, particularly during the smog season and would be an ideal test site, especially since valuable ozone data were being furnished by air pollution agencies. It is interesting to note the gradual drop in ozone concentration each year reflecting the efforts of air pollution agencies to reduce smog and ozone concentrations in the Los Angeles area.

Since styrene rubber is the most widely used synthic in military applications, considerable effort was directed toward the compounding of this material for improved ozone resistance. The concurrent development of improved methods of accelerated ozone testing greatly facilitated the task of screening various types of antiozonants. The results of preliminary evaluation indicated that antiozonants, when at levels of three parts of dioctyl-p-phenylenediamine in combination with 1 to 2 parts wax per 100 parts RHC, would provide adequate protection for styrene rubber in many applications.

The use of improved types of antiozonants, with suitable waxes, has proven to give satisfactory protection for one year or longer against ozone cracking after exposure to the high ozone atmosphere at Pasadena, California. As a result, the present military specification for tires (MIL-T-12459A) requires that new tires manifest ozone resistance comparable to Ordnance Controls containing 2 parts Santoflex AW, 2 parts of UOP-88, and 1.5 parts Atlantic No. 1115 wax per 100 RHC. In addition, ozone resistance is called for on many Ordnance mechanical rubber items, referenced by Suffix $C_1$ of specifications MIL-R-3065 and MIL-STD-417.

In addition to conducting exposure tests at Los Angeles, identical items were also exposed at other test sites. These sites included the Detroit Arsenal; Yuma, Arizona; Philadelphia, Pennsylvania; Dayton, Ohio; San Antonio, Texas; Fort Greeley, Alaska; and Fort Churchill, Canada.

In comparing the degree of cracking of like items in Los Angeles area and the other parts of the country, it is estimated that one year of exposure in Los Angeles is equivalent to approximately 3 to 5 years in other areas where the average ozone concentration is between 3 to 10 pphm as compared to 10 to 66 pphm in the Los Angeles basin. Due to the fact that the antiozonants gradually migrate to the surface and are consumed in 3 to 5 years, a definite limitation is placed on the period of ozone protection afforded by the antiozonants compounded into the rubber. Therefore, if tires or other rubber items in storage are to be protected beyond this period, it may be necessary to surface coat them with an antiozonant such as a 50/50 mixture (by volume) of dioctyl-p-phenylenediamine (MIL-D-50000) and acetone.

## Conclusions

The results of the Ordnance Corps Pasadena exposure tests may be summarized as follows:

(1) The ozone resistance of synthetic elastomers, particularly styrene rubber, can be substantially improved by the addition of suitable antiozonants and waxes to the rubber compound.

(2) The one to two years protection at Pasadena appears to be equivalent to 3 to 5 years protection in other areas where ozone concentrations are low.

(3) Butyl and chloroprene rubbers which have inherent high ozone resistance become less effective when plasticized to meet military low temperature requirements, and require the addition of suitable antiozonants and careful compounding in order to regain their ozone resistance.

(4) Polyurethane rubbers promise to play an important role in the manufacture of many end items used on military vehicles when it becomes economically available.

(5) For storage purposes a surface coating with a 50/50 mixture of dioctyl-p-phenylenediamine and acetone promises to impart good ozone resistance to tires that were not protected against ozone during manufacture.

Note: The opinions expressed or contained herein are not to be construed as official or reflecting the views of the Department of the Army.

# Factors Influencing the Ozone Resistance of Neoprene Vulcanizates under Flexure

EFFECTS OF OZONE ON RUBBER

By R. M. MURRAY

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IN the first study, 20 proprietary materials were tested at the five part level as antiozonants for cured Neoprene Type W compounds. The antiozonants were divided into three groups: (1) additives which had no appreciable effect on ozone resistance; (2) those that had a moderate effect in delaying ozone attack; and (3) antiozonants which were highly effective. The accompanying table gives a listing of the chemicals of each group.

All of the strong neoprene antiozonants in Group 3 except NBC had an adverse effect on scorch rate but to a greatly varying degree. Thermoflex A provided a higher degree of protection than most of the Group 3 chemicals, yet the compound containing it had relatively good scorch resistance. The weaker antiozonants in Group 2, with the exception of Stabilite, did not affect scorch rate so greatly as the majority of those in Group 3, and so can be utilized with more assurance of processing safety.

Also, the effect of various combinations of wax and antiozonant was studied. Contrary to results reported with other elastomers, two parts of Heliozone wax did not impair neoprene's ozone resistance under dynamic testing, but rather was somewhat beneficial. Even four parts wax was generally beneficial. Neoprene ozone resistance increased linearly with increasing amounts of Thermoflex A antiozonant. Also, in the range of ozone concentrations studied, time to ozone attack was very nearly proportional to ozone concentration.

Vulcanizates containing varying volumes of three different fillers (MT carbon black, hard clay and whiting) were compared. Ozone resistance decreased with increased loading. Greater loadings could be tolerated with MT carbon black than with the mineral fillers for a given degree of ozone resistance.

Since neoprene ozone resistance depends considerably on the type of plasticizer used, twelve different plasticizers were compared in the same base formulation. All cured compounds containing petroleum oils had comparable ozone resistance even though the oils varied considerably in composition. The vulcanizates containing petroleum oils were somewhat more ozone resistant than those containing resinous hydrocarbons, a polyether and all but one of the ester plasticizers (butyl oleate).

The vulcanizate containing a furan derivative (Furatone 1547) was so much better than the ones containing petroleum oil that this material can be classified as an antiozonant for neoprene. However, even more outstanding was linseed oil, which provided exceptional ozone resistance when ten or more parts were present. Although unsaturated oils, such as linseed, will protect neoprene, they have little or no effect in protecting butadiene-styrene or natural rubber. Neoprene ozone resistance increased somewhat when specimens were heat aged prior to testing. This was the case for vulcanizates containing petroleum oil as well as ones containing linseed oil.

Another experiment was designed to compare the dynamic ozone resistance of 13 vulcanizates prepared from eight different commercial elastomers as well as 50/50 blends of several of them. Vulcanizates of nitrile, butadiene-styrene and natural rubber showed relatively little ozone resistance when compared to others in the study. Three parts of UOP-88 greatly improved the static ozone resistance of butadiene-styrene rubber, but was only moderately effective in improving ozone resistance under dynamic conditions.

A Paracril Ozo vulcanizate was found to be very good in ozone resistance under constant strain conditions, but not outstanding by dynamic tests. The dynamic failure was unique in that relatively few, but very deep, cracks were formed. A butyl rubber vulcanizate was unusual because its resistance to dynamic tests was somewhat greater than to static tests. The cracking was like that observed with the Paracril Ozo vulcanizate.

As might be expected, a 50/50 blend of neoprene and Hypalon was more resistant to attack than neoprene alone. Hypalon and Viton vulcanizates were completely unaffected by 300 pphm ozone even under dynamic testing conditions.

CLASSIFICATION OF NEOPRENE ANTIOZONANTS

(5 parts per 100 parts neoprene)

| Group 1 (No appreciable effect) | Group 2 (Moderately effective) | Group 3 (Highly effective) | |
|---|---|---|---|
| No antioxidant or antiozonant (Control) | Agerite White | Antox | Santoflex AW |
| 2 parts Neozone A antioxidant (Control) | Octamine | NBC | Akroflex CD |
| 5 parts Heliozone Wax (Control) | Neozone A | BLE-25 | Thermoflex A |
| Zalba | Stabilite | UOP-288 | Flectol H |
| Antioxidant 2246 | Neozone D | Akroflex C | Agerite Resin D |
| Santowhite Crystals | | UOP-88 | Aminox |

# How Republic Rubber Solved Two Safety Problems

FIG. 2—Republic Super-Grip conveyor belt successfully adapted for use as a non-slip floor mat. The various nozzles are in the rack provided for them.

By A. B. MAINES *Director of Safety & Employment, Republic Rubber Division, Lee Rubber & Tire Corp., Youngstown, Ohio*

TWO interesting methods of guarding against injury are being used at Republic Rubber, the Industrial Rubber Products Division of Lee Rubber & Tire Corp., Youngstown, Ohio.

Note: This article first appeared in the March, 1959 issue of Monitor magazine, published by the Industrial Commission of Ohio, and has been reprinted by permission of the magazine.

FIG. 1—Guard on windup cover rolling table (arrow indicates switch on the hinged side of the shield).

One method is to use a shielding device at the cover rolling table in the hand-built hose department. This shield is hinged on the side of the table opposite the control (the rod running the length of the table), used by the operator during the normal process. The switch used at this point is the ordinary spring-type foot switch which requires constant pressure to activate the windup. This same switch is used on the hinged side of the shield (see arrow in Figure 1). Closing the shield presses the contact on this switch activating switch No. 1 for the table control bar. Raising the shield de-activates both switches but permits the use of the switch on the hinged side as a jog button for starting the liner on the shell.

## A Non-Slip Floor Mat

Slips and falls while stripping large suction hose were a long-time hazard. Particles of lubricating agents, mixed with water from wet wrappers, made the concrete flood a veritable skating rink. Injuries were common. Every known anti-skid measure was tried, including wood planking, but the dangerous slips and falls continued.

Partially as a desperation measure we took a piece of Republic Super-Grip package conveyor belt, punched holes in it for drainage and placed it, gripping side up, on the floor (Figure 2). It was our thought, and we were correct, that the hundreds of small rubber gripping teeth, designed to prevent slippage of packages while being conveyed up or down, would provide safe footing in this area.

Successful? Well, there have been no slips or falls in this area in over five years and the original installation is still in use.

# EDITORIAL

## Questions of the Month

► THE questions asked of business paper editors in a given period of time are indicative, we believe, of the large matters which are causing concern in the particular industry served by the editor. During the past few weeks, the following questions have been asked with some degree of frequency:

**What is happening to natural rubber prices?**

**Any news about stockpile?**

**Have the strikes at major rubber manufacturing plants affected the statistical picture?**

The interesting thing about all three questions is the interrelationship which exists between them. During the past month, natural rubber prices, basis No. 1 R.S.S., have fallen by about four cents a pound. Several factors combined to force rubber prices down, among them the strike; rumors of stockpile rotation revisions, and lessened world demand.

For some reason, the Soviet bloc nations have withdrawn from the market. This action, of course, has caused a good deal of uneasiness in primary markets. Singapore particularly was sensitive on this point. Stockpile rumors added to this uneasiness. In the United States, meanwhile, it has been estimated that the strike caused some 25,000 long tons to have been lost from the consumption totals. The Rubber Manufacturers Association reports that consumption of new rubber in May declined to 110,750 long tons from April's 121,222 long tons.

Now there is a plus side to all of this. Lower rubber prices will likely induce the Soviet Union and her satellites to re-enter the market. The automobile industry has already produced over 3 million passenger cars, and there are indications that production will continue at this pace for the balance of the year. This means, historically, a high level of activity for the domestic rubber industry. The strike situation could then force a higher consumption rate in the balance of the year. Tire inventories in the United States are not high — and this is another favorable factor pointing to increased demand.

There is always a temptation to take daily, short-range developments and try to multiply them into a yearly picture. To our eye, nothing has happened so far this year to materially affect earlier estimates.

- The natural rubber industry will have a very good year indeed with a possible deficit in supply over demand.
- Consumption in the United States of both natural and synthetic rubber will be at or near a new record.
- Per capita consumption of rubber throughout the world will establish a new high.
- Synthetic rubber will capture about 65 per cent of all the rubber consumed in the United States in 1959.

There does seem to be something for everybody in 1959!

Special Industry Report

# The Wage Incentive Problem in the Rubber Industry

**John A. Patton Management Engineers, Inc., a consultant firm whose services include all phases of management practice, has earned a pre-eminent position in industry for its knowledgeable approach to wage incentive problems. Also, the firm has the acceptance of labor in establishing sound wage incentive plans. In 1946, the firm was cited by the New York Museum of Science and Industry "for outstanding achievements in the equitable solution of the problems of labor and management", and "for many constructive contributions to the furtherance of industrial life in America." During the past two years the Patton firm has conducted seminars for many companies in the rubber industry on the incentive problem and its relationship to cost and profits, and has acquired particular insight into this question as it pertains to the rubber manufacturer and his employee.**

**T. J. Wieczorek, who has assembled this article for RUBBER AGE from the findings of the company, has been associated with the firm for the past 14 years and has been a principal since 1953. He is personally conversant with wage incentive plans in the rubber industry as a supervisor of large scale revisions and from taking an active part in contract negotiations.**

WAGE incentive plans in the rubber industry are a thorn in the side of top management. So much so that some executives are now discussing the possibility of abandoning wage incentives as a productivity tool. What are the conditions in this industry that would precipitate such a drastic break with tradition?

For one thing, next to the problems inherent to rubber processing itself, wage incentives cause more trouble than any other single factor. Secondarily, the cause of this mounting headache is not peculiar to the individual company, but is industry-wide in scope—therefore, not easily resolvable.

In essence, the heart of the matter is simply that over the years the union has become intelligently dominant in the settlement of rate disputes. In fact, the union has placed greater emphasis on the value of using well trained and orientated industrial engineers than has management. They choose men to represent the union viewpoint who have worked with their hands in the shop, and, therefore, understand the problems of the people they are dealing with. They choose men who are accustomed to talking to the worker on his own level, and more important, these men are trained in the human relations aspect of their job.

It is not enough to assume that union industrial engineers have achieved their high degree of effectiveness because they are union men talking to union men about union problems. If this factor is the only point of differentiation, why is it that the union industrial engineer can most often get a slowdown to cease? The fact of the matter is that their influence is the deciding factor even in disputes in which they oppose the immediate interest of the worker.

### What Does Management Do?

What must be management's answer to this costly situation? Must they abandon their only sure means of increasing productivity because they cannot cope with the problems attendant to it? A sound wage incentive system is too potent a factor to allow it to be discounted by default.

First of all, management does not have adequate representation in the plant. The company time study men are no match for their opposite members in the union. Consider the facts:

(1) The average company price tag on a chief industrial engineer is $10,000 to $12,000; whereas a capable man's floor price is $15,000 and up.

(2) Time study engineers range from $375 a month for a junior to $675 for a group leader. (The average s.t. shop rate for an incentive worker is $2.75 per hour which equals $473 per month.)

(3) The chief industrial engineer reports to the plant superintendent when he should report to an executive in the ranks of top management. We have learned that plant superintendents do not have the policy making authority necessary to effectively administer an incentive plan.

(4) When business recedes, industrial engineering is one of the first departments affected by cutbacks. Does the union whittle their complement accordingly? It is almost like cutting the advertising budget when business is bad.

(5) The department is limited to rate setting work. It is unfortunately

true that many managements consider wage incentive problems as irritants that interfere with deliveries and absorption of burdens. When incentive disputes arise, they do not seem to realize that resulting grievances, relaxed standards, and arbitration decisions can establish unworkable and untenable precedents. Their de-emphasis of the industrial engineering function is predicated on a false assumption.

In an effort to establish a sound approach to wage incentives, management must examine the basics of its position. The weaknesses now inherent to management's equity in production revert to the blanket installations of an accepted incentive system which measured true work load without consideration of incentive opportunity for all time worked. Machine attention time was completely obviated in the mechanics of this plan.

As a result, the industry has been forced to recognize "process delay" or use complex negotiated conversions of true incentive earnings based on actual work load to pay schedules. Any negotiated schedules are unrealistic.

### Laboratory vs. Millroom

In the area of rate setting, management's house is divided against itself on millroom practices. The laboratory dominates process time, since it is charged with the chemistry of rubber, but seldom does one find a lab man who understands wage incentives—or even has an interest in this subject.

As a result, standards are too often established at a low task because a factor of safety is included in the recipe. Earnings become lop-sided as inequities arise—the culmination of which is pegged production by the employee. What can management do to head off this costly situation? For one thing, the time study department can train an ex-mill man as an engineer. He, then, can translate the lab requirements into number of passes—not time in the mill.

Second, he knows that wet ingredients can be added in a certain manner to accelerate mixing time. He knows how to add the dry materials with dispatch, using aids—such as slits without breaking the band.

Consequently, the ex-mill man can establish a standard which is representative, containing a minimum of process time and still offering an attractive incentive opportunity to the employee. He can do this while still satisfying the chemists' requirements. Can your industrial engineer do this for the company? Remember one thing from an analysis of this basic: if the lab dominates the millroom, the wage incentive system is in trouble in this area.

The forced practice of average earnings with which management has been saddled when off-standard conditions occur is a direct result, in many cases, of unrealistic base rates. That is to say, the low task—low base rate plan coupled with relaxed standards has required the use of average earnings—which in turn has led to "caps" on earnings. When the plan places a limit on employee earnings, it has the effect of changing the incentive from: "How much can I earn without killing myself," to "How can I earn this limit with the least amount of work." The incentive plan, under these conditions, soon becomes an incentive not to extend maximum effort.

Once the incentive plan deteriorates to the point where average earnings are used to an excessive degree, the cancer has set in. It is only a matter of time before the plan will become a liability to management. Incentive by inference as well as definition is a reward for extra effort. How can a sound plan remain effective when an employee can earn the same or approximately the same money during machine breakdown or while waiting for work. Management cannot damage its equity in production by guaranteeing 100% coverage, anymore than labor can insure management against the increased cost of absenteeism. Management can and should compensate the employee, however, for his loss in changing from an incentive to a daywork task when incentive work is available.

The alternative to average earnings lies in the following steps:

(1) Base rates that are attractive on a daywork basis should be implemented.

(2) A high task incentive plan should be installed to allow for high base rates.

(3) Average earnings must be used only in experimental work, training or irregular conditions such as employee transfer from an incentive to a daywork operation when incentive work is available.

**Why wage incentive plans are a thorn in management's side—**

- **Inadequate representation in the plant.**
- **Blanket installations of systems which measure the true work load without considering incentive opportunity for all the time worked.**
- **Domination of the millroom by the laboratory.**
- **Excessive use of average earnings.**
- **Misuse of the foreman and his function.**

### The Forgotten Man

Now let us examine one of the most glaring weaknesses of incentive plans in the rubber industry today. The foreman, commonly referred to as the "forgotten man of industry" is really "forgotten" in the rubber industry. Since seasonable fluctuations were a part of the industry pattern, it soon became accepted practice to transfer foremen into the ranks during slow periods. This practice has persisted and is now all too prevalent in many companies. In fact, management has not yet progressed to the realization that the foreman occupies the pivotal position in the maintenance of an incentive plan; success or failure is dependent upon his effectiveness.

How can a management expect foremen with low seniority to properly police an incentive plan if they are transferred in and out of the bargaining group? Surely the performance of master sergeants in the field during the war would have been impaired if they had been repeatedly put back into the ranks. Would their identity and loyalty be with the brass or with the troops? The communicative and authoritative link to the men in the ranks would be weakened and broken.

It is just not in the cards to manipulate behavior patterns and then expect outstanding results from individuals. If management wants a well administered incentive plan, it must make supervision a permanent member of the management team. If management is to maintain a well administered incentive plan, it must train supervisors properly in their role in the administration of the incentive plan.

Without these prerequisites, the best designed plan is doomed to failure. We have found in over 15 years experience with incentive installations and revisions that the number one reason for incentive failure is the foreman's inadequate training and participation in the plan's administration. It is management and management alone who is responsible for the ineffective plans that are in existence today.

The problem of mounting production costs in the manufacture of industrial products is forcing many companies to disband individual plant operations. It is tragic to see this solution used by any management particularly in areas where an industry is a substantial part of the economy.

Is this drastic action necessary? A workable alternative can be attained through effective incentive plans which will lead to a competitive plant—highly productive, yet paying high wages. The decision rests in the hands of management.

# News Reports and Industry Activities July 1959

## Senate Subcommittee Holds Hearings on Tire Sales Practices

► A subcommittee of the Senate Small Business Committee, headed by Sen. Humphrey (D., Minn.), held a three day hearing at which independent tire dealers charged that present tire sale practices by manufacturers are pushing the dealers out of business. No specific legislative changes were proposed by critics of tire manufacturers. The small business panel can make recommendations, but cannot originate any type of legislation. Any change in the anti-trust laws would have to originate in the Senate or House Judiciary committees.

A major witness, W. W. Marsh, executive secretary of the National Tire Dealers and Retreaders Association, stated that practices which are injurious to small business are: (1) sales by tire producers through local, company-owned stores; (2) sales directly to customers by field sales organizations maintained by tire manufacturers; and (3) sales by local users through independent tire dealers "but at prices set by the manufacturers."

### *Tight Control Charged*

Sometimes, Mr. Marsh said, such retail prices are less than those charged by the dealer, who gets only a small service charge out of the transaction. Manufacturers were charged with "using their enormous assets to capture new business and to control the tire distribution business right down through the retail outlets to the ultimate user."

In further hearings, however, the Federal Trade Commission stated that direct consumer sales are legal. FTC chairman Earl W. Kintner advised the senate group that this is a form of competition and a possible source of benefit to the tire user. According to Mr. Kintner, it is not legally mandatory that the traditional distribution system in business, from manufacturer to wholesaler to retailer, be followed in all sales.

Spokesmen for manufacturers said that the tire industry does more for its retail dealers than any other industry, and that many services are provided to dealers at little or no cost. It was explained that the Federal government and certain national corporations want their tires delivered where needed and billed from a central office. It was also pointed out that some contractors and truckers need special sizes not stocked by dealers.

A bill introduced by Sen. James E. Murray (D., Mont.), and now pending in Congress, would prevent companies from selling directly to users and compel them to channel sales through local merchants. Company witnesses said that they were opposed to this bill. Leonard Smith of U. S. Rubber said, "It is our view that a buyer of tires at any level of consumers is and should be able to purchase his requirements through any channel of distribution that suits his tastes and needs." Independent retailers have a field in which they can serve adequately, he said, but there ought not to be a law "which would enable them to hold on to portions of distribution which they can no longer handle at a satisfactory profit and serve the purchasing public at a free competitive price."

## Wyrough and Loser Names Agents

► Wyrough and Loser, Trenton, N. J., has recently completed arrangements with several companies for the sale of Poly-Dispersions outside the United States. The following companies will be representatives of the Wyrough and Loser line: W. A. Bekaert, Brussels, Belgium; Rubber Regenerating Co., Ltd., Manchester, England; Naugatuck Chemicals, Elmira, Ontario, Canada; Agentuur En Commissie Handel, Overveen bij Haarlem, Holland; Gart, Torino, Italy; Peter Endresen AFTF A/S, Oslo, Norway; Arnold Otto Meyer, Hamburg, West Germany; and H. Kern & Co., Venezuela.

## General Tire Makes Girdles

► General Tire & Rubber Co., Akron, Ohio, has announced that it is manufacturing a new rubber girdle for the Sleex Products Co., a division of the Formfit Co., Chicago, Ill. The new girdle, called Sleex, is made of Airelon a specially blended rubber composition developed after two years of joint research by Formfit and General Tire. The girdle is completely molded in one piece and is lined with cotton which is absorbent and will last the life of the garment, the company states.

## Kennecott, Okonite Merger Cited in Antitrust Suit

► The Department of Justice filed suit on June 22 to force Kennecott Copper Corp., New York, N. Y., to divest itself of the Okonite Co., Passaic, N. J., which it acquired last fall. The suit filed in a New York Federal Court, charges that the acquisition may substantially lessen competition in the copper industry in violation of the Clayton Anti-trust Act. The government also alleged that consolidation might prompt other mergers and acquisitions in the industry. Section 7 of the Clayton Act, as amended in 1950, prohibits acquisitions whose effect "may be substantially to lessen competition, or to tend to create a monopoly."

### *Background of Acquisition*

Kennecott acquired Okonite last November through a share-for-share exchange of its stock for Okonite's 231,398 outstanding shares. Kennecott was described in the complaint as one of the largest domestic producers of copper, while Okonite was described as one of the largest independent fabricator of wire. The Justice Department charges that Kennecott's acquisition of Okonite eliminated competition between the two companies in the sale of various kinds of copper wire and cable. It also charges that the merger enhances Kennecott's competitive advantage over other copper producers and wire and cable fabricators and tends to lessen competition in the production and sale of copper, copper content products, and copper wire and cable.

According to the government, there has been increasing concentration in copper production as the result of a string of mergers and acquisitions. All of the leading copper producing companies have joined in this merger movement and most major producers have acquired copper fabricating facilities, the Department of Justice said. It was stated that 70 per cent of the long term growth between 1915 and 1945, of the three largest domestic copper producers had resulted from acquisitions and mergers. It was this trend and the growing tendency by producers to absorb fabricating companies, which played a major role in the Congressional decision to strengthen the Clayton Anti-trust Act in 1950.

### *Seeks Court Order*

The suit also seeks a court order to prevent Kennecott from acquiring other companies engaged in the production, fabrication or sale of copper or related products. Kennecott has issued a statement that "although we have not seen the complaint, we are confident we have not violated the law in the acquisition of the assets of Okonite Co."

## Goodyear Chemical Division Conducts Rubber Seminar

► The Chemical Division of Goodyear Tire & Rubber Co. held a rubber seminar on June 2 at the Waldorf-Astoria Hotel in New York City, in connection with the 5th World Petroleum Congress. A description of the rapid growth of the synthetic rubber industry and the even more spectacular advancements expected as a result of new products now being groomed in the laboratory, was presented to more than 100 management executives of rubber fabricating companies from all over the United States.

Appearing at the seminar for the Goodyear Chemical Division were R. E. Davis, director of business research; M. E. Wendt, development manager, chemical products; B. A. Rosinski, manager, Houston plant; and J. D. D'Ianni, assistant to the vice-president of research and development.

The first speaker, Mr. Davis, discussed "Growth and Change." He stated that the American economy is a dynamic growth and change economy. Growth and change, he said, will continue to provide many new business opportunities in the years ahead. He stressed that we are living in a highly dynamic period when yesterday's economic facts and thinking are as dead as yesterday's newspaper. To succeed, we must gear all of our planning to the size, character and vigor of our ever changing markets, he stated.

### *Assured Processability*

"Assured Processability with Synthetic Rubber" was the subject of the talk presented by Mr. Wendt. He pointed out that the transfer of styrene-butadiene rubber manufacturing plants to private ownership in 1955 has not only helped the rubber manufacturing companies, but has also been of real value to the rubber consumer. Styrene-butadiene rubbers produced since 1955 have been improved in quality, color and uniformity, he stated. The introduction of new types of styrene-butadiene rubbers has enabled rubber consumers to formulate end products having equivalent or superior quality at reduced costs.

He then discussed Goodyear's Plioflex line of synthetic rubbers and stated that although it is physically impossible to supply rubber having identical processing properties from lot to lot, the assured processability test being run on Plioflex rubbers is designed to screen out the poor processing rubber that might cause processing problems in the customer's plant.

Mr. Rosinski spoke on "The Effect of the APF Test on Plant Operations." He stated that based on experience to date, the APF test has accomplished the following in plant operations: (1) It checks quickly any changes that are made in plant operation that could affect processability; (2) It predicts the processability of any new polymer that may be introduced before release to customers; (3) It has helped bring about the establishment of a program which has revealed a considerable amount of information on the factors that affect processability in less time. Mr. Rosinski noted that before a single pound of Plioflex is released for shipment it must pass, at a minimum, 15 tests, and more tests are being requested and added continuously.

The final speaker at the seminar was Mr. D'Ianni, who spoke about "Some Recent Developments in Synthetic Rubber." He remarked that the petroleum industry and the synthetic rubber industry are inextricably bound together since the raw materials for most synthetic rubbers are petrochemical in nature. In discussing the major developments in synthetic rubber, Mr. D'Ianni stated that the synthetic rubber industry is now one of the giants of industrial chemistry. Not only has natural rubber been duplicated, but it has been improved upon immeasurably in certain properties.

Top row (left to right): Richard L. Silver, Paul R. Kemp and Hugh P. Campbell. Bottom row (left to right): John E. Meyer, William N. H. Potterton and James J. Broderick.

## Cyanamid Forms New Sales Force

► Rubber Chemicals Department of the American Cyanamid Co., New York, N. Y., has established six sales posts as a part of a recently initiated program to form its own staff for the sale of company products directly to the rubber industry. Company personnel will be located at four offices. The Chicago and Akron offices will serve customers in 24 states from Canada to the Gulf of Mexico. Northeastern states will be covered by the Providence, R. I., office, while areas along the eastern seaboard to Florida, will be served by the Bound Brook, N. J., office.

Richard L. Silver, formerly a vice-president of the Akron Chemical Co., has been named district manager of Cyanamid's new rubber chemicals sales office in Akron, Ohio. He will be assisted by Paul R. Kemp, who was also with Akron Chemical, and Hugh P. Campbell, previously associated with the B. F. Goodrich Chemical Co. John E. Meyer, formerly with Herron & Meyer, has been named sales representative with headquarters in Chicago, Ill. William N. H. Potterton, who was previously associated with Ernest Jacoby & Co., has been named district manager for Northeastern states and James J. Broderick, who has been with the company for eight years, will serve customers along the eastern seaboard.

## Major Rubber Firms Sign URW Contracts

► The record breaking strikes which brought operations to a standstill at three of the "big four" rubber companies and idled about 55,000 workers, has been settled. Firestone Tire and Rubber Co., the last company to settle its differences with the United Rubber Workers, signed a contract on June 12. Goodrich and the URW came to terms on June 9, while the strike at the U. S. Rubber Co. was terminated on May 2.

Working conditions and pension plans were the major issues. At the time of this writing, terms of the Firestone and U. S. Rubber agreements were not available. However, it was stated that the new contracts are similar to an agreement signed by the Goodyear Tire and Rubber Co. last April. Goodyear was the only company in the big four to avert a strike.

The Goodrich-URW collective bargaining agreement covering working conditions and SUB, runs until June 9, 1961, while its pension, severance pay and insurance agreement has a July 1, 1964 termination date. The new agreement provides that a normal pension will be paid on the basis of $2.40 per month for each year of service prior to January 1, 1959, and $2.50 monthly for each year of service after January 1, 1959. A worker becomes eligible for normal retirement after 10 years of service at the age of 65.

### *Previous Arrangement*

In the previous agreement, a worker accumulated normal pension benefits at the rate of $1.80 monthly for each year of service up to a limit of 30 years. A formula which tied in with social security benefits was then in effect. The new pension-figuring system eliminates deductions because of social security.

It was found that in the switch to the new system, some of the company's 1,237 employees who will be eligible for normal retirement in the next five years would receive smaller pensions than they would have under the previous contract. The new agreement provides that the company will make up the difference so that those who would have suffered a loss will get pensions equal to those which they would have received under the former plan.

For those who have been on pensions under URW agreements, increases to provide benefits of $2.25 monthly for each year of service are provided. Disability benefits, after 15 years of service, are provided on the basis of $4.80 per month for each year of service before January 1, 1959, and $5 per month for each year of service after that date. An early retirement plan is also provided in the new agreement and service awards are continued.

The contract also calls for improvements in insurance provisions and in the collective bargaining agreement and operational changes in the SUB program. Wages were not discussed at any time during negotiations. It is believed that the question of wages will be raised by the URW late this summer.

The impact of the strike, the longest in the history of the rubber industry, was felt in many quarters. Goodrich stated at the end of May that 200 to 400 of its employees might lose their jobs as a result of the walk out. The company explained that it had lost many customers who had been forced to turn to competitors not on strike in order to preserve their business.

On June 1, it was reported that the then seven week old strike was expected to create some tire shortages in retail channels within a few weeks if the labor disputes were not soon settled. Another report stated that the strike had crippled 25 per cent of the industry and deprived the United States of 4,200,000 tires.

Dwight M. Wilkinson

## Named Litzler Vice-President

► Dwight M. Wilkinson, founder of Ovens for Industry, Inc., and executive vice-president of Ryan Industries, has joined the C. A. Litzler Co., Inc., Cleveland, Ohio, as vice-president in charge of sales. Litzler recently acquired the Ovens for Industry Division of Ryan Industries in order to broaden the Litzler line of continuous processing equipment involving heat transfer to cure and treat synthetic filament webs, coated metals and plastic materials. Mr. Wilkinson, a registered professional engineer who attended Case Institute of Technology, started his career in this field with Industrial Ovens Inc., where he held the post of chief engineer.

► Compounding Research Report No. 28-A on "Polygard" is available from Naugatuck Chemical Division of U. S. Rubber Co., Naugatuck, Conn.

## FTC Charges 15 Firms With Tire Price-Fixing

► The Federal Trade Commission charged 15 firms on June 12 with conspiring to fix prices on tires and tubes. All of the major rubber firms are involved as well as the Rubber Manufacturers Association and the Tire and Rim Association Inc. Companies cited were: Goodyear Tire and Rubber Co.; B. F. Goodrich Co.; Firestone Tire and Rubber Co.; General Tire and Rubber Co.; Seiberling Rubber Co.; Mohawk Rubber Corp.; U.S. Rubber Co.; Armstrong Rubber Co.; Cooper Tire and Rubber Co.; Dayton Rubber Co.; Dunlop Tire and Rubber Corp.; Gates Rubber Co.; Lee Rubber and Tire Corp.; Mansfield Tire and Rubber Co.; and McCreary Tire and Rubber Co.

The complaint states that manufacturers have adopted and maintained a "single zone" price system which fails to give nearby buyers the natural freight benefit. Under this system, prices quoted by the "Big Four" tire producers to all customers of a class throughout the entire country, regardless of the location and differences in freight costs, are indentical or substantially matched, and those quoted by other producers are lower by an agreed-upon differential. FTC states that the result is that near-by purchasers not only are deprived of advantages in delivered costs they otherwise would get, but they are compelled to pay part of the costs of transportation of more distant purchasers.

### *Exchange of Information*

Other charges are that these firms exchange confidential information on prices and terms; use RMA's "cost accounting formula" as a basis for price-fixing, charging according to RMA's formula instead of basing the price of products on actual costs; have adopted "uniform policies" for special promotions such as Decoration Day, July 4th and Labor Day sales.

An executive of General Tire said a "preliminary study of the charges and the complaint" has led the company to "believe that trial of the case will show them to be unfounded." Goodrich stated that the issues were "very complex," and added it "probably will have something to say about them once the lawyers get through going over them." Firestone and Goodyear have withheld comment.

## To Simplify Capital Structure

► U. S. Rubber Reclaiming Co., Buffalo, N. Y., has announced that it plans to submit to its stockholders a plan to simplify its capital structure. The purpose of the plan is to eliminate arrearages of unpaid dividends on its two classes of preferred stock and permit the common stock to be put on a dividend-paying basis, the company reports.

# Dewey & Almy Opens New $4 Million Facility

► Dewey and Almy Chemical Division, W. R. Grace & Co., Cambridge, Mass., has announced the opening of a new plant at Owensboro, Ky., to manufacture polyvinyl acetate polymers and copolymers, butadiene-styrene synthetic rubber latices, and battery separators. The $4 million facility, Dewey and Almy's 15th plant and seventh in North America, went on stream in June.

According to George W. Blackwood, president of the Dewey and Almy Chemical Division, the Owensboro plant doubles the division's total capacity to produce polyvinyl acetate emulsions and butadiene-styrene latex, which are used by the rubber, adhesives, paint, paper, textile and plastic industries. Total latex and vinyl emulsion capacity at Owensboro is 20,000,000 pounds a year. The plant raises by 30 per cent the capacity for resin impregnated fiber separators for the storage battery industry.

Mr. Blackwood stated that new polyvinyl acetate units at Owensboro will help to fill a demand for Dewey and Almy's vinyl emulsions by the paint industry. The division's existing and projected market for high styrene copolymer latices necessitated the doubled latex facilities, Mr. Blackwood said. The latices made by the company are used as paper coating binders, as ingredients in carpet backings, and in the manufacture of box toes and specialty papers.

### *New Facility Described*

The Owensboro plant, of concrete block and asbestos siding over steel, covers two acres of floor space in four major buildings including an organic chemicals reactor building, organic chemicals storage building, battery separator building, and an office laboratory and warehouse building. The plant is set on a 143 acre tract three miles northeast of Owensboro on the Ohio River.

The facility has been designed for almost unlimited expansion. The organic chemicals section is laid out in two straight, parallel lines, one followed by the polyvinyl acetate product flow and the other by butadiene-styrene. The arrangement provides maximum efficiency of operation in the storage of raw materials, the preparation or mixing area, the reaction area, the product storage area, and the loading dock.

Basic raw materials, or monomers, are brought into the preparation area through automatic metered equipment at the single push of a lever, accurate to one pound in 6000, the amounts being automatically corrected for volume change due to temperature induced expansion and contraction. An automated "cascade" temperature control system oversees batch temperature, the critical factor in the polymerization of basic raw materials.

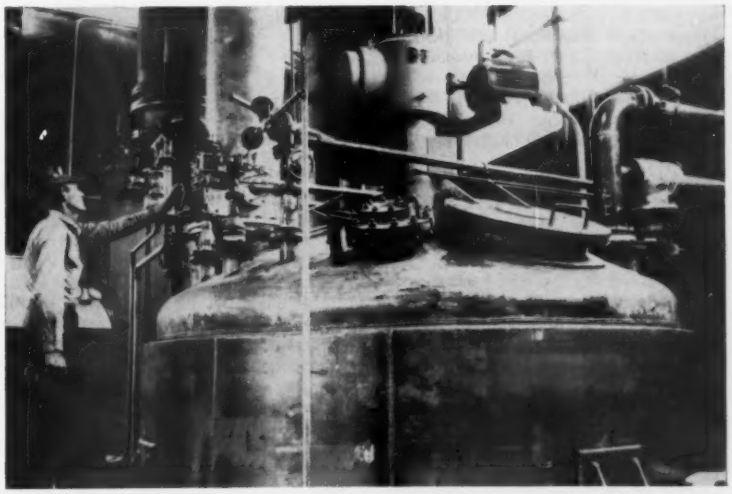
George W. Blackwood (left), president, Dewey and Almy Chemical Division, W. R. Grace & Co., discusses the division's new Owensboro facility with RUBBER AGE staff editor Bernard M. Berns.

Reaction control instrumentation is centered in a control room containing specially designed equipment. Modern meters and valves on all tanks and lines assure mixing of precise proportions of ingredients. All mix tanks and reactors are polished stainless steel, to minimize coagulation in product batches and provide ease of maintenance.

Storage facilities include indoor tanks ranging up to 15,000 gallons. Polyvinyl acetate or butadiene-styrene latex ordered by a customer is passed through filters to insure freedom from coagulation in final product and held for delivery in special hold tanks. The loading dock can accommodate three tank trucks and a tank car at the same time, and is designed to load drums with equal efficiency.

Like the organic area, the battery separator building also features control panels which centralize the production of several million separators each week. Rolls of cellulose fiber are impregnated with resin, then drawn through a drying oven which processes hundreds of feet of continuously moving stock at one time.

The impregnated stock is then passed down a manufacturing line which impresses forged ribs for rigidity; applies to the surface a microporous plastic coating; reinforces the ribs with additional plastic; cures the sheet; and chops it into correct sizes for packaging and shipment. Electric motors driving the components of the line are synchronized by a central "brain." Fumes from the resins, and heat generated in some of the processes, are carried off by a ventilating system which pushes 120,000 cfm of fresh air into the building.



Close-up of butadiene-styrene reactor showing some of the control mechanisms which govern the manufacturing process of rubber latex compounds.

# Southern Rubber Group Meets

## June 5-6 Meeting Features Two Technical Sessions and Election of New Officers

► Approximately 176 members of the Southern Rubber Group met for a technical program at the Colonial Inn and Desert Ranch Motel in St. Petersburg, Florida, on June 5 and 6. Featured at the meeting were two technical sessions, one on "Recent Developments in Black Masterbatch," and the other on "High Speed Vulcanization."

A highlight of the official program was the announcement of newly elected officers who will assume their functions at the next meeting of the Group in Memphis, Tenn., in October. Those chosen to serve are: *Chairman*, Eldon Ruch (Firestone, Memphis); *Vice-Chairman*, Roger Pfau (Texas-U. S.); *Treasurer*, Martin Samuels (Copolymer Rubber & Chemical); *Member of the Board of Directors, Supplier*, Charles White (Godfrey L. Cabot), and *Member of the Board of Directors, Manufacturer*, Robert Camp (Goodyear).

A business meeting preceded the first technical session on the afternoon of June 5. At this time the treasurer's report and a report from the membership committee were made. The assembled members voted on a motion made at the previous meeting of the Group that the treasurer serve a two-year term rather than the one-year term in effect at the current time. The motion was carried, and so recorded.

The evening of June 5 was devoted to a banquet at which the guest speaker was Capt. F. J. Schaemelle of Delta Air Lines. Capt. Schaemelle spoke on the current projects underway by commercial airlines for the addition of jet service, and what this portends for the traveler. Jack Valero (Hofran & Co.) served as master of ceremonies. A suppliers' hospitality cocktail party preceded the banquet, and the room was also open after the end of the formal program for the members and their wives.

### *Black Masterbatch Panel*

The panel on "Recent Developments in Black Masterbatch," which met on the afternoon of June 5, featured three speakers: Dr. R. A. Forrester (United Rubber & Chemical), whose subject was "The Production of Dispersant Type Black Masterbatch;" Martin Samuels (Copolymer Rubber & Chemical), who spoke on "The Production of Non-Dispersant Type Masterbatch," and Ralph LaPorte (Seiberling Rubber), who addressed the Group on "The Use of Black Masterbatch in Compounding."

Dr. Forrester began his talk with a brief history of the dispersant type black masterbatch. He continued with a discussion of the nature of the dispersing agents, which separate the individual particles of the black in a liquid and keep them apart until the agent is neutralized or removed, and of their action. Dr. Forrester then went into detail regarding the physical character of the slurry using these agents, and the manufacture of the masterbatch.

Continuing his address, the speaker analyzed production advantages associated with the dispersant type black masterbatch. These include preparation of higher solids slurries; storage benefits; and ease and accuracy in changing from one type dispersant masterbatch to another.

Dr. Forrester next discussed the good processing properties achieved by the masterbatch, and presented data on the physical properties of the vulcanizates, particularly stress-strain characteristics. He presented comparative information on effects of different polymers and on the same latex as supplied by three different producers. Comparisons of quality of oil and of black were also made, and information suggesting that there is little effect on cure rate by use of the dispersant type black masterbatch presented.

### *Processing Properties*

Dr. Forrester concluded his address with comparisons of the physical of tread stocks made with and without the dispersant type black masterbatch. As presently manufactured, it also meets other requirements placed upon it, achieving the best average between cure rate, tensile, Mooney, extrusion, and flexing, as required by a variety of fabricators.

Mr. Samuels in his address on the non-dispersant type masterbatch began with a history of carbon black masterbatches during the time they have been on the market since 1944. He analyzed the deficiencies originally associated with the carbon black masterbatches, and the technological advances which made possible the non-dispersant type.

The speaker continued with a detailed discussion of black masterbatch production advantages and problems. A primary advantage of the dispersant-free system is that it is not necessary to have large tanks to store water dispersions of the black. Contact time with water, thought to be deleterious to the surface characteristics of the blacks, is shortened, also a definite advantage. Exclusion of salt from the coagulation process reduces the washing requirements and yields a product with much lower percentages of soluble material than found in some conventional masterbatches or in most styrene rubbers.

Advantages to the rubber processor, as described by Mr. Samuels, include economic, processing and quality ones. In regard to the latter, it was stated that the non-dispersant type masterbatch will show higher tensiles, elongation and resilience than dry mix control stocks, while at the same time exhibiting somewhat lower modulus values. Power consumption is lower, and mixing times shortened.

### *Notes Available Types*

Mr. Samuels closed his address with comments on the 26 or more types of non-dispersant masterbatches available to the industry. He urged that the lack of standardization inherent in a large number of masterbatches, which limits interchangeability, be minimized. This problem can be reduced if consumers give consideration to using blends of existing types of masterbatches to obtain desired black and oil concentrations.

Mr. LaPorte in his talk on the use of black masterbatches in compounding centered his remarks mainly on manufacturing procedures, economics and product quality. He warned that though it is a simple matter to calculate material, handling and transportation costs, black bonus and similar costs, it may be the unexpected factors which will tip the balance one way or the other.

Mr. LaPorte commented on the experience of his own company in improved appearance in the storage area, less dirt in other than mill room areas, improved morale, shorter mixing cycles than originally calculated, definite improvement in operation of tube machinery, and an increase in the uniformity of cured physical properties.

### *Elimination of Variables*

The improvement in the tube operation—reduction in stock which had to be reprocessed, less trouble in setting up, and production of treads more uniform in profile and weight—Mr. LaPorte credited to the elimination of variables attendant on the incorporation of and the dispersion of the carbon black by the dry mix method.

The speaker concluded his talk with comments on compounding techniques and the improved quality of tread stocks made with black masterbatches.

He then showed processing data from the experience of his company which indicate the power consumption savings available from using black masterbatch stocks.

### *Vulcanization Panel*

The panel on high speed vulcanization, which met on the morning of June 6, also featured three speakers. They and their topics were: Dr. B. B. S. T. Boonstra (Godfrey L. Cabot), "Vulcanization by High Frequency Methods"; D. B. Cofer (Southwire), "Continuous Vulcanization"; and M. A. Schoenbeck (DuPont), "Liquid Metal Curing."

Dr. Boonstra discussed dielectric heating as a means of vulcanization. This is effected when an electric alternating current causes the dipoles in an insulating material to orient themselves in the direction of the field. Since the field is switching directions at the prevailing frequency, the dipoles turn back and forth, the movement producing friction with the surrounding molecules and causing heat development.

The greatest single advantage of dielectric heating is that the heat is developed everywhere all through the compound, and vulcanization is uniform throughout. Disadvantages include the necessity for thorough dispersion of materials so that the rubber to be heated is electrically uniform; frequency and voltage gradient limitations; temperature coefficient factor difficulties with some materials; and possible difficulties due to size and shape of the object.

Dr. Boonstra then spoke at length on the dielectric requirements of compounds. Natural rubber, styrene rubber, butyl rubber and polyethylene rubber have too low a loss factor to be heated efficiently. Nitrile rubber, neoprene and phenolformaldehyde rubber have much more favorable power factors, and by compounding with fillers their power factors can be changed over a wide range. The speaker also presented data on other aspects of the process and other polymers.

### *Continuous Vulcanization*

Mr. Cofer in his talk spoke of the "continuous vulcanization" (CV) process by which rubber compounds used for wire and cable insulation are applied by extrusion and then vulcanized in a continuous operation. The essential facilities for the CV process are the rubber extruder and jacketed steam tube in which high pressure steam is confined.

Recent improvements in the basic CV equipment include special screw design for room temperature stocks, incorporation of a screen pack between the screw and head, vertical steam tube with extruder on an upper floor and steam seal in the basement of a two or three story building, steam tubes installed with a catinary curve to prevent drag in the tube, non-contacting automatic diameter control, improved heating and cooling facilities on extruders, and numerous other features.

Mr. Cofer commented on the success of the CV method as dependent on the ability of the compounders to control heat history while mixing and the ability of the extruder to run stocks which are highly accelerated.

Continuous vulcanization has been furthered by the introduction of the room temperature process, which entails the use of a compound in which accelerators and vulcanizates are added in the initial mixing operation and no further warming or mixing is required. Mr. Cofer continued his talk with a discussion of the processing procedures and advantages associated with the room temperature process. He also presented physical data on stocks that had been run at higher speeds than have been obtainable with the room temperature process.

The last speaker of the technical program was Mr. Schoenbeck, who discussed continuous curing by the DuPont LCM (liquid curing medium) method. With this process extrusions pass directly from the extruder into a curing tank where they are exposed to a liquid curing medium at temperatures of 400 to 600°F.

Mr. Schoenbeck analyzed processing advantages obtainable with the continuous process, mainly cost savings resulting from reduced handling and thus lower labor requirements, and savings from lower in-process inventories. Less scrap will also result. He continued with detailed information on the equipment involved, heat transfer media (molten metal or heat-stable organic liquids), and compounding considerations.

In connection with the latter the speaker analyzed compounding principles which must be followed to prevent porosity in neoprene compounds without the aid of a vacuum extruder. Preventing porosity with a vacuum extruder and curing systems for neoprene were also described.

New York Rubber Group members watching the baseball game at the summer outing at Doerr's Grove, Millburn, N. J.

## 225 Members Enjoy New York Group Outing

► The New York Rubber Group held its summer outing on June 4 at Doerr's Grove, Millburn, N. J., with 225 members attending. The festivities began at noon and the members partook of such refreshments as clams on the half shell, clam broth, hot dogs, sausages, hamburgers, beer and soda. The day's activities were under the chairmanship of Dick Glidden (Ames Rubber), with M. R. Buffington (consultant) serving as co-chairman. In charge of the numerous events were: *Ball-In-Barrel,* Ralph Ambrose (Rodic Rubber); *Baseball,* Al Gessler (Esso Research and Engineering); *Bocci,* Glen Vickery (General Tire); *Hit-The-Bottles,* Jim Weaver (Harwick Standard); *Horseshoes,* Bill Lamela (Okonite); *Golf,* Robert De Lack (New Jersey Zinc); *Basketball,* Gordon Voigt (Niagara Rubber); *Fly Casting,* Lou Haas (Ames Rubber); and *Darts,* Endrik Anvelt (Ames Rubber).

In the early evening the group enjoyed a hot roast beef sandwich plate, salad, coffee and ice cream. After dinner prizes were awarded to event winners. They were: *Bocci,* Ken Chester (C. P. Hall) and Herb Watjen (Vansul); *Horsehoes, First Prize,* Andy Rusin (Raybestos-Manhattan), and *Second Prize,* Bill Lamela (Okonite); *Golf, First Prize,* Larry Capitini (American Biltrite), and *Second Prize,* C. V. Lundberg (Bell Laboratories); *Basketball, First Prize,* R. Stimetz (United Carbon), and *Second Prize,* T. Jones (Okonite); *Fly Casting,* J. Scopelitis (Special Packing Co.); *Darts, First Prize,* Edmund Winiarski (Luzerne Rubber), and *Second Prize,* W. Schon (Schon Tool); and *Baseball,* winning team captained by Art Bald (Columbia-Southern), Al Gessler (Esso Research and Engineering), J. Jones (St. Joseph Lead), R. Verbeck (Ames Rubber), S. Rutkowski (Sindar Corp.), and Messrs. Higgins, Rudeav, Daly, Ritzinger and McKeefery.

# Senate Cites Synthetic Program

## "Solo" Report Critical of Some Aspects of Government-Sponsored Activities

► The government's role in the technological development of synthetic rubber has come under the searching scrutiny of a Senate subcommittee as part of a study of the patent system of the United States. A recently issued report by Robert A. Solo, Department of Economics, College of the City of New York, for the Senate Subcommittee on Patents, Trademarks and Copyrights, is critical of many aspects of the government-sponsored synthetic rubber program.

In a foreword to Professor Solo's report, Joseph C. O'Mahoney (Dem., Wyo.), chairman of the subcommittee, states: "Perhaps the most striking and revolutionary of recent events in the field of technological research and development has been the increasing role played by the Federal Government. What this may ultimately mean for the future of private research, the patent system and other time-honored institutions, it is still too early to say.

"Government support in this area has taken various forms. One of these has been to turn over to private industry the research and development tasks, with the Government footing the bill. Despite its pervading importance in terms of subject matter, results and financial outlay, surprisingly little attention has been given to examining and evaluating this procedure from the standpoint of its desireability, performance, and promotions of the national security and public interest."

### *Author's Views His Own*

Senator O'Mahoney goes on to explain that the author's views are entirely his own and that publication of the report does not signify acceptance by the Subcommittee. However, he feels that the study "represents a valuable contribution to patent literature and that the public interest will be served by its publication."

The interests of private enterprise and the public welfare are in many instances diametrically opposed, according to the author, and in his report, he demonstrates that this opposition of interests played a major role in the failure to create an effective industrial program to develop new synthetics and to meet production schedules.

His major thesis is that at the time of World War II, and even now, we do not have "the kind of competence that we need for effective government in this age of science and technology."

"In order to formulate policy criteria suitable to the complexities of science and industrial technology, government must have the requisite competence," he states. "The competence it requires is not only such mastery of science and technology as might be provided by experts borrowed from industry or a university. It must indeed encompass this mastery; but it also must embody an understanding of the values of nation and community and the processes of social evaluation, compromise and choice which are the very essence of governing."

Conceived under wartime pressures, a program was set up in which investment and operating costs were to be borne by the government and plants were to be government-owned. However, planning of the industry was a private company conception. The author stresses that private industry was not to be blamed for the failure. It had, at least, offered a program, which was not forthcoming from any other sector. However, he points out, in this regard the private companies were assigned to fulfill a task they were not equipped to handle. The government, on the other hand, did not attempt to cope with the work of building the industry, but merely financed it.

The author feels that the government did not in this instance "give a thought to the logical collision of private and public interests and tried to harness the dynamics of the profit motive to winning the war, a 'social' and 'strategic' end."

Governing agencies left technical evaluation to private officials who could evaluate operation feasibility, but, the author states "this meant that the conflicts which central planning and the relative availabilities of resources which should have been taken into account, were not taken into account."

### *Technical Competence*

Professor Solo states "Technical competence is not abstract, but is always rooted in a complexity of values, objectives, and points of views. The technical competence of the company engineer is deeply rooted in the objectives of his company and the universe of a value relationship which is characteristic of his industry, and that competence cannot be relied upon for evaluation that stands on criteria of social weal and strategic strength. Nor can that competence be easily and quickly transformed into the competence appropriate to the processes of government."

Operating within their own spheres, the companies used sound judgment. "The program was adjudged technically feasible by the private companies, and it was technically feasible. It worked, eventually. The program was adjudged commercially sound by the private companies, and it was commercially sound. Eventually it was proven to be a good money-maker."

In terms of the war-time need, and in meeting its own goals, the synthetic rubber program failed for the following reasons:

"a) Plans were laid with insufficient regard to the conflicting demands of other war programs.

"b) The time delays inherent in bringing complex innovative processes into full-scale operation were underestimated as were the difficulties of converting equipment to the fabrication of synthetic rubber and of converting products to the greater use of synthetics.

"c) The administrators failed to foresee, through anticipatory product and processes research and testing or otherwise, the development of limiting bottlenecks; and, when the bottlenecks occurred, were unable to evade or break them.

"Above all" Professor Solo states "what blocked and limited the program were the shortages of equipment, raw materials, and manpower. The crucial conflict was precisely the one the critics had forecast: the conflict with the demand for high-octane aviation fuel and the production of petroleum derivatives."

### *Research Motivations*

Another major phase of the program was to introduce new materials to replace the increasingly crucial natural rubber. In this, the program failed also. Professor Solo felt that private organizations involved in the research program were not properly motivated to bring forth new development because of the war-borne technology patent pool. He believes that the companies did not even try for major breakthroughs.

As they were aware that their discoveries would be available to competitors as soon as commercial conditions were introduced in the synthetic rubber market, the companies simply conformed to the letter of the rule and went through the "motions of research and development." The author stresses that private concerns were neither unethical nor unpatriotic, but that they were geared to market operations and market incentives. The government sponsored program removed these incentives. Of the patent and technical

interchange agreements, the author states:

"1) The agreements were designed to minimize the immediate problem of negotiation under the stress of wartime urgency.

"2) The agreements did fix the level of government liability.

"3) They eliminated the profit incentive that companies might otherwise have had to develop lower cost processes and better products for the Government-owned industry.

"4) They created a positive deterrent to the incorporation of new and more efficient methods into the Government operation.

"5) The elimination of the agreements permitted a hidden sphere of private research to develop, but no new inducement was offered for the development of improved processes or products in the plants operated by these companies for the Government, or for the incorporation of more efficient known methods into Government operation.

"6) Some provision was made in the patent agreements to facilitate turning over patent rights and technological information to the prospective purchasers of plants. Often, however, these provisions were vaguely worded and their value as safeguards was uncertain. The value was to be indicated in subsequent events.

"7) No provision was made to assure that patent rights and technical know-how would be generally available to newcomers in the industry other than potential purchasers of Government plants—an assurance that would have encouraged the creation of competitive conditions in the future."

In the period of postwar Government ownership and control of the industry, there were some important technological developments. Those listed were the development of cold rubber and oil-extended GR-S; conversion of oil feedstocks into butadiene; the black masterbatch technique; cold-resistant butyl; high-abrasion carbon blacks; a synthetic "natural" rubber.

All but one of the above-mentioned developments were introduced by companies which were not included in the government research program . . . and the last, the development of a synthetic "natural" rubber, did not take place until after the government research program was discontinued. The author stresses, however, "this was the principal reason why it was contemplated that the program of Government research would be maintained even after the transfer of private facilities into private hands."

The author concludes "The survey indicates that Government subsidy of research standing alone will not suffice. It is not enough to rely on reputable companies and well-known scientists. The mechanism of action and self-interested motivations must not be lost sight of, as it frequently was in this program. A Government research program, to be effective must have leadership; a leadership that is clearly moti-

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vated, powerful, knowledgeable and responsible; one that is prepared to stand or fall on the basis of results."

The government must and eventually will assume a new role, according to Professor Solo. "No longer limited to its role of mere financial angel, occasional trustbuster and guarantor of the legal parameters of private choice, government will be obliged and is being obliged to participate over the whole range of technological choice, to undertake independent research and development, to juxtapose social values to private goals and to impose the general and public interest when in contravention to the particular or commercial interest."

However, the author believes that government research in synthetic rubber, properly organized, might be continued even now in areas where the "commercial incentive to development is not proportionate to their relative importance in terms of strategic needs and the social well-being of the Nation."

Suitable projects listed are:

"1) Long range fundamental research."

"2) Research directed toward the development of materials of strategic value."

"3) Research into the development of alternative processes, alternative supplementary materials, or alternative polymers, which might aid in war planning or facilitate the industrial mobilization for war."

"4) Research directed toward the development of techniques of plant reconversion and materials conservations and other specific techniques of mobilization and war control."

Professor Solo warns, that "one lesson pointed up by the experience in synthetic rubber, is that any research and development program must be directed and run by a technically competent and responsible authority which stands accountable for the results, and whose position and reputation and/or monetary reward will be determined by the failure or success of that program."

## United Carbon To Move Offices

► United Carbon Co., Charleston, West Va., whose principal offices have been located in Charleston since the formation of the company 35 years ago, has announced that it will begin the gradual transfer of its executive and departmental headquarters to other cities. According to reports, United Carbon's executive offices will be moved to Houston, Texas; the marketing headquarters will shift to New York City; and remaining departmental headquarters will go to Houston. The Appalachian area office of the firm's Gas and Oil Division will be retained in Charleston. The company stated that the decision to move was dictated by various geographical circumstances affecting the company and its operation today.

## Columbian Carbon Research Center

► A new research center has been opened at Princeton, N. J., by the Carbon Black and Pigment Division of the Columbian Carbon Co., New York, N. Y. According to the company, all phases of research and development in carbon black, pigments and related fields will be undertaken at the new headquarters under the direction of Dr. Carl W. Sweitzer. The facilities, located on a 14 acre site, consist of two one story buildings. Designed for basic chemical and physical research, one building includes administrative offices, a library and six laboratories. The second building contains a group of seven large laboratories for development and applications research activities, a large conference room and several machine shops.

## Estane VC Polyurethane

► B. F. Goodrich Chemical Co., Cleveland, Ohio, has announced the development of a new thermoplastic elastomer called "Estane VC." The company reports that the material offers extremely high tensile strength at high ultimate elongation, with excellent solvent resistance, particularly to gasoline. In addition, it provides low air permeability and outstanding abrasion resistance. Estane VC is available in the form of tough, rubbery, clear amber granules which are converted into end products by milling, calendering, extrusion or molding. Goodrich expects the first major application to be in the field of wire and cable jacketing. Other potential uses, according to the company, will include fuel hose, small bore tubing, belting, coated fabrics, sheeting for equipment liners, engine mounts, valve diaphragms, pump components and insulators.

## Thiokol Ends Merger Talks

► Thiokol Chemical Corp., Trenton, N. J., has announced that J. W. Crosby, president of Thiokol, and Roy E. Marquardt, president of Marquardt Corp., have mutually agreed to discontinue negotiations to merge their respective companies. According to reports, thorough investigation by both companies led to the conclusion that a merger was unfeasible. Mr. Crosby and Mr. Marquardt emphasized that their decision to discontinue negotiations will have no bearing on the operation of the individual companies.

## Predicts Increased Production

► The world production of natural rubber, now running at a rate of approximately 1,900,000 long tons per year, will increase to over 2,000,000 tons and will approach 2,100,000 tons within the next few years, according to Leong Hoe Yeng.

Mr. Leong, past chairman of the Rubber Producers' Council of Malaya, and currently a member of the Malayan Rubber Fund, is currently visiting in the United States. At a luncheon tendered for him at the Hotel Plaza in New York on July 6, Mr. Leong also predicted that the production of natural rubber in Malaya will rise from its present annual rate of 660,000 long tons to 800,000 to 850,000 tons within the next few years.

The Malayan rubber executive expressed the belief that the future of the natural rubber industry was dependent on increased yield per acre and indicated that the program of the Malayan government for helping smallholders to increase such yield was proceeding quite satisfactorily. He also stated that a price of 30 cents a pound for natural rubber was quite satisfactory to most Malayan producers, some of whom have already brought their own production costs down to 15½ cents a pound.

Mr. Leong expressed complete confidence in the ability of natural rubber producers to maintain their fair share of the rubber market despite the growing importance of synthetic rubber to rubber goods manufacturers throughout the world.

## Abstracts of Papers to be Presented at the

# International Rubber Conference

## Washington, D. C.—November 8-13, 1959

► As a convenience to the readers of RUBBER AGE, abstracts of all the papers to be presented at the forthcoming International Rubber Conference are published herewith. Sponsored jointly by the Division of Rubber Chemistry, A.C.S., the Rubber and Plastics Division, A.S.M.E., and Committee D-11 on Rubber and Rubberlike Materials of A.S.T.M., the Conference will feature twelve technical sessions, some of which will be held concurrently. In addition to the technical sessions, various activities have been planned including exhibits, plant visitations, sight-seeing trips, luncheons and banquets. Readers are urged to watch future editions of RUBBER AGE for additional meeting details. Note: Abstracts published here represent the complete meeting program as announced to date. Changes or additions to the program will be noted in future issues.

### Monday, November 9

Morning Program

Session A—Equipment and Processes in Rubber Manufacturing

Session B—Elastomers and Engineering Materials

Session A

**The Rotomill—A Continuous Mixing Device.** ***A. E. Juve, J. R. Beatty (Goodrich Research Center), and R. H. Kline (National Rubber Machinery).*** The Rotomill, a continuous mixing device for rubber-like materials is described. It consists essentially of a rotor surrounded by a stator. The rotor surface has rounded lands and flutes arranged in a spiral form to knead and shear the rubber while advancing it through the machine. The clearance between the rotor and stator is adjustable so allowance for different intensities of shearing or for normal wear is possible. It is possible to compound, mix and extrude products such as tire treads, hose, or weatherstripping in one operation by adding a short extruder section to the output end of the Rotomill. The advantages of a continuous mixing process are discussed and typical results for dispersion, physical properties, and uniformity given.

**New Rubber Processing Techniques for the Sixties.** ***A. H. Hale (Hale and Kullgren).*** In our profession we are in continuous contact with engineers, technicians and operators from various rubber concerns and, without exception, they are emphasizing the importance of better dispersion in mixing and a more uniform conformance to a predetermined plasticity. Therefore, the processes selected for discussion in this paper will be confined to greatly improved methods for mixing, warming and plasticizing rubber stocks. Variation in quality is much greater when a process is composed of a plurality of manually controlled operations. We will, therefore, attempt to show how present mill room operations can be reduced in number and simplified by the application of a unique mechanism.

A new and modified automatic mill has shown considerable promise and can properly be expected to receive substantial interest in the rubber industry. At the start, existing mills can have the equipment installed adjacent to either roll but later the advantages gained by higher productivity, will compel use of larger rolls operating at unprecedented speeds. Its function is to greatly intensify the milling action at selected intervals during the material flow from one end of the working roll to the other. It also accepts and discharges the stock automatically. No attendant will be required and its product, as already demonstrated, is uniform in plasticity and dispersion. Our paper will disclose a mill room which should arouse the interest of the entire industry. An upgraded product will be produced with less plant investment and less labor.

**Basic Equipment for Producing Flexible and Rigid Polyurethane Foams.** ***J. M. Buist (Imperial Chemical Industries).*** The development of polyurethane foams marks the beginning of a new era in the rubber and plastic industries. Whilst they are not alone as new materials to these industries, they are unique in the challenge which they make by their demands for novel machines and techniques. Their success depends as much upon engineering as upon chemical skill. Polyurethane foams can be flexible or rigid depending on the type of polyhydroxylic compounds used. Equipment for the continuous production of flexible foam employing a mixing head which operates at very low pressures will be described.

The development of low toxicity isocyanates, e.g., diisocyanato diphenyl methane compositions have enabled production methods to be developed whereby rigid polyurethane foams can be foamed-in-place in restricted spaces without danger or difficulty. These methods have depended both on the development of special chemicals, and on portable machines for metering and pumping the correct ratios of ingredients to the mixing head. In order to reduce wastage and give the operator greater control of the mixing and delivery operations, a mixing head incorporating several novel features, including a quick acting stop/start device, has been designed. The principles of this head are also of interest for the intermittent production of molded flexible foam articles.

Equipment for foaming-in-place by spraying through a twin-feed spray gun device has also been devised. This equipment can handle polyether and polyester prepolymers for flexible foam and also the high viscosity rigid foam materials. The new gun is self-cleaning and is much less liable to failure from blockages than commercial two-feed spray guns.

Session B

**Elastomers in Naval Machinery.** ***E. M. Herrman, J. S. Post and S. U. Patton (U. S. Naval Engineering Experiment Station).*** Development of various elastomers are continually being made to determine their suitability for various naval applications. These elastomers may be in the well-known forms of mechanical packings or gaskets or other almost unique forms such as membranes for separation of fuel from sea water in ships' tanks, condenser tube

plugs for nuclear power plants, preformed foamed thermal insulations, bearings for propulsion shafting, or isolation mountings for machinery in nuclear submarines. The development and performance of elastomers for these and other naval applications are discussed. The discussion includes the development of methods of testing and describes the almost unique properties required for naval applications.

**Urethane Polymers as Engineering Materials.** ***J. G. DiPinto (DuPont).*** Liquid urethane elastomers offer an attractive route to promising candidate materials for engineering applications. They may be varied from very soft to very hard products which bridge the gap between conventional elastomers and rigid plastics. These materials exhibit resilience, high extensibility, and resistance to cold flow usually found in elastomers, combined with load bearing capacity and hardness approaching those of plastics. High strength and resistance to abrasion, oil, and solvents increase the value of these materials to the design engineer.

The properties of liquid urethane elastomer vulcanizates may be varied over a wide range by chemical modification. This is of particular value in designing elastomeric compounds for specific engineering uses. This paper describes the properties of a family of urethane products in terms of interest to the design engineer. Load bearing properties, the effect of shape factor on compression/deflection, creep, and behavior under dynamic stresses are included. The use of these data for the design of actual products will be illustrated.

**Effects of Composition on Flow Properties of Polymeric Sealants.** ***J. Gaynor, G. W. Blum, E. G. Babolek and C. P. Alexander (Case Institute of Technology).*** The flow properties of a number of mastic compositions designed as optical sealants were evaluated. An extrusion rheometer was designed to permit the determination of flow rate at constant elevated pressure. The mastics were blends of variable proportions of five individual components: low molecular weight polybutene resin, micro-crystalline wax, rosin ester, carbon black, and petroleum jelly. The concentration of four of these components was systematically varied over a broad range and the effect of composition on flow properties was determined. The results of the work showed that the flow rate, V, is related to pressure, P, by the equation

$$P = CV^S \qquad (a)$$

where C and S are empirical constants which were determined for this system. All experiments were performed at room temperature. Pressures were imposed hydraulically.

Constants "C" and "S" were found to vary with composition. Therefore, it appeared that equations relating "C" and "S" to the concentrations of the components could be derived. The derived equations are:

$$C = \exp \left\{ -1 + \frac{a_1 (X - X_o)}{W - W_o} + a_2 (Y - Y_o) + a_3 [(Z - Z_o) - (V - V_o)] [1 - (W - W_o)(Y - Y_o)] - [(W - W_o)(Y - Y_o)] \right\} \qquad (b)$$

$$S = b_1 (X - X_o) + b_2 (Y - Y_o) + b_3 (Z - Z_o)(W - W_o - 1) \qquad (c)$$

X = Vistanex B-100 (weight per cent)

Y = Plasticizer (petroleum jelly) (weight per cent)

Z = Microcrystalline Wax (weight per cent)

V = rosin ester (Hercolyn) (weight per cent)

W = Ratio of wax to rosin

$X_o$, $Y_o$, $Z_o$, etc. are emperically derived zero values of the individual components, and constants $a_1$, $a_2$, $a_3$, $b_1$, $b_2$, $b_3$, etc. are emperically derived virial coefficients. Since the amount of carbon black was maintained constant throughout the work, its effect was not derivable. As a result, carbon black concentration is a factor which is implicit in the constants of the equations. Although the derivation was specific for this system, the success of the approximation suggests possible generalizations of a similar type for other equally complex multicomponent systems.

## Monday, November 9

### Afternoon Program

### Tires

**What Bladderless Curing of Tubeless Tires Can Mean in Increased Productivity.** ***George N. Murphy (National Rubber Machinery).*** The history of curing (vulcanization) of automotive tires is typical of process development in the tire industry. There is a continual search for more efficient methods as well as processes that yield improved product quality. From the time when most tires were cured on solid cores through the present with the curing done on bladders and air bags, there have been attempts at bladderless curing of tires. That is curing with internal pressure media in direct contact with the inside tire carcass. It was recognized early that such a method would increase efficiency with the result in substantial cost savings. In 1914, when the tire industry was in its infancy, a U. S. patent was granted to one M. A. Dees incorporating a bagless cure apparatus.

After the advent and general acceptance of tubeless tires in the industry, there has been greatly increased activity toward devising a satisfactory bladderless cure method. Since a gas impervious liner is inherently used in tubeless tires, it is reasoned that no additional ply coating is needed when curing without a bladder. While many satisfactory tires have been cured by various bladderless devices there has always been a severe handicap to the mechanical handling of the tire or to the quality of the finished tire. I will illustrate a practical method of bladderless curing with the resulting increase in machine productivity and manufacturing cost savings.

We have found that a practical bladderless curing device must have the following features: (1) Be free from interference with automatic or semi-automatic press curing operations. (2) Be able to mechanically form the tire beads of various widths. (3) Be able to enter the green tires and extract from the cured tires without damaging the tire carcass. (4) Be able to readily adjust to various tire sizes and specifications.

We have designed a split, inner bead forming ring that collapses well inside the circumference of a given tire bead ring. This enables us to load and unload the tire molds in the same manner used on bladder type presses. The forming surface on the inner bead ring is of resilient material that enables it to "iron out" the inside surface of the tire bead during the vulcanizing process. It forms the bead by pressuring the bead mass to a predetermined shape.

The inner bead forming rings are introduced into the green tire when the tire is swelled by internal shaping pressure, thus the bead forming ring never scuffs the inside tire surface. This inner forming ring is readily adjustable to various bead widths through the use of an external adjusting screw. We have utilized this simple adjustment to incorporate the entire range of bead widths of any given bead diameter. This enabled us to devise a so-called "universal" bead toe ring on which we can cure, for example, the range of size tires from 6.40-15 through an 8.20-15 on the same bead ring.

The values to workable bladderless curing have long been recognized as two-fold. In addition to the elimination of the bladder in itself, the shorter cure time realized by the bladder elimination is most important. To illustrate this savings, I point out that in common practice curing a 4-ply passenger tire on a conventional bladder type press, the cure time is 20 minutes. With no other factors except cure temperatures changing, it is practical to reduce this cure by 30 per cent by use of the bladderless cure method. To further discuss cost savings, we must deal in

generalities since there is a wide variation in process costs and accounting methods from one tire manufacturer to another. However, here are listed the most tangible cost savings:

1. Elimination of bladder.
2. Elimination of green tire lining cement.
3. Increase mold turnover by 25-40 per cent.
4. Increase press (vulcanizer) and auxiliary equipment turn over by 25-40 per cent.
5. Elimination of bladder changes and bladder preparation (labor and press down time).
6. Increase of productivity per foot to floor space by 25-40 per cent.

In some instances the above savings can amount to as much as 11½c per tire. Great progress has been made in the process of tire vulcanization with considerable effort being put into the development of a bladderless cure method. I believe we now have a practical approach. Universal acceptance will follow only after comprehensive testing of our device and method.

**Worldwide Developments in Tire Production.** ***C. A. Litzler (C. A. Litzler).*** There have been many major advances in tire design and construction as well as in tire production capacity itself. This paper will summarize these major aspects and will also include a related section covering the tire fiber situation throughout the world. The first portion of the paper will discuss tire carcass reinforcing fabrics and will include a summary statistical review of the world fabric situation in the last several years. It will cover the major trends in the uses of various fibers, which are now apparent. Newer fibers will be included.

The current situation regarding the use of rayon cord fabric, nylon, Perlon, polyesters, glass, polyurethane and other fibers, as well as wire, will be discussed. The use of these materials in the United States, Europe, the Orient and Australia, and other countries, where information is available, will be included. The second section of the paper will summarize the recent changes in tire design and construction. It will cover such subjects as the use of dual denier cords, unbalanced rubberized fabric, ply construction, glass fiber tires, wire tire construction. All of these advances are producing an impact on tire industry and could very likely determine the future course of the industry on a worldwide basis.

The final section of the paper will discuss the current developments in the productive capacities in the major countries throughout the world. Comparison of numbers of vehicles, miles of road, population, capacity of existing tire plants (where information is known) will be given. The situation in the United States, Europe, South America, Mexico, Japan, Russia, Satellite countries, Australia, Middle East, Africa and India will be analyzed.

This portion of the paper covers broad statistical information about world areas which might require future tire plant installations to keep abreast with the future industrialization of these areas. The paper will be illustrated with technical data on the fabric materials discussed, drawings and photographs of the tire design improvements and geographical and statistical tables, covering the general dispersal of the plants in the countries covered in the paper.

**Aircraft Tire Testing Developments.** ***H. P. Lamb (Adamson United).*** A concise review of basic laboratory equipment for the testing of aircraft brakes, wheels and tires and a discussion of their instrumentation and drives. More and more emphasis has been placed on the accuracy of measurements taken on these testing machines as aircraft equipment is designed to give the ultimate in capacity with a limited life. Therefore, accuracies within a few per cent help to show even small improvements in design. Recent improvements in aircraft design have resulted in the need for faster, heavier and more accurate laboratory machines for the testing of aircraft brakes, wheels and tires.

These recent developments have made present laboratory equipment inadequate, and many laboratories are being equipped with new testing machines incorporating several new features. Programmed speeds and loads may be set on the testing machine by drawing the desired curve on graph paper. Yaw and camber attachments simulate cross wind and one-wheel landings. The addition of drop test rigs over the road wheel has made possible shimmy tests and complete landing gear assembly testing.

**Power Wastage in Tires.** ***G. B. Roberts (Dunlop Rubber).*** Studies described relate to the rolling resistance of free rolling tires and attempts to determine where in the tire structure the major losses occur. Results, obtained on laboratory test machines, extend over a range of load, inflation pressure, speed and tire running temperature, and include different polymers and tire sizes. Some road test correlations are discussed.

An outline description of a new test machine being developed for the measurement of tire power losses under driving or braking conditions is included. The principle of this machine is novel and it allows direct measurement of torques and tire losses without wasteful absorption in the test machine mechanism. Some results are presented and discussed.

**Power Loss and Operating Temperature of Tires.** ***R. D. Stiehler, M. N. Steel, G. G. Richey, J. Mandel and R. N. Hobbs (National Bureau of Standards).*** This paper summarizes the work at the National Bureau of Standards during the past ten years on the measurement of power loss and operating temperature of tires. The power loss was measured in the laboratory using a steel wheel 1/300 mile in circumference for the roadway. The work included a study of the effect of speed, load, inflation pressure, tractive effort and slip angle on power loss. Both commercial and experimental tires were used in this work. The experimental tires made possible a study of the effects of type of rubber, black and cord on power loss. The relationship between power loss and the rise in temperature of the contained air was studied as a function of the various factors.

**The Mechanical Behavior of the Tire in Dependence on Materials and Construction.** ***W. Hofferberth (Deutsche Dunlop Gummi).*** The properties characterizing the mechanical behavior of the pneumatic tire are first considered and it is shown that these mechanical properties can be attributed on the one hand to the spring action of the tire and on the other hand to the movements between tire and road. The spring action itself is in its effects to a large extent dependent on the properties of the materials used in the tire, their interaction in accordance with the constructional build-up and on the geometrical shape of the tire, whereas the movements between tire and road are determined by the surfaces and their relative displacements, i.e., by the friction problems associated with the behavior of the rolling tire.

For the spring behavior and its dependence on the chemical constructional and geometrical build-up data of the tire, an equation based on the minimum principle was already given in a previous paper. A corresponding equation for the movements between tire and road is derived with the help of the classical theory of elasticity.

The two equations for the spring action and the movements between tire and road are more closely considered. In the course of this, the influence of the chemical, constructional and geometrical tire data on the individual mechanical properties of the tire are discussed. For two of these tire properties examples are given showing the dependence of the mechanical behavior of the tire under chemical and constructional changes. Finally, the accuracy of the equations is dealt with and reference is made to the possibility of other equations for the purpose of obtaining more exact results.

**Stresses in Deflected Tires.** ***W. F. Ames and H. G. Lauterbach (DuPont).*** This paper considers the problem of the stress distribution in the cord body of an inflated tire, deflected by an external load. The calculation

of stresses in an inflated but otherwise unloaded tire (a problem described in the literature) is facilitated by the symmetry of the tire. This symmetry makes it possible to reduce the three-dimensional problem to a two-dimensional case for which the stresses and cord tensions can be found in analytic form from the static equilibrium equations.

Unlike the inflated, unloaded tire the inflated, deflected tire is not a surface of revolution and therefore lacks three-dimensional circular symmetry. It is shown how the stress problem in this more general case can be solved. Results are given for circumferential, meridian and shear stresses for specific tires and comparison with experimental data is presented.

## Tuesday, November 10
### Morning Program
Tires

**Retreading of Tires.** ***H. Geldof (Rubberinstituut).*** After retreading of a tire, the bonding strength between the new tread and the old rubber layer has to be sufficiently high. In order to check the influence of retreading conditions on bonding strength, the development of a reliable adhesion test was required. This adhesion is influenced by several factors (buffed rubber layer, composition of the tire and of the tread compound, pressure applied in the airbag, temperature of vulcanization, a.s.o.). Whereas the variables are so many, a comparison of the adhesion values obtained under varying conditions is only possible if a statistical method is used.

As a design of experiment based on all possible variations would require the retreading of hundreds of tires, it was necessary to decrease this number and to carry out preliminary tests. A survey is given of the importance of different factors, viz.: direction of buffing, cement concentration, degree of humidity, cushion layer, type of camelback and vulcanization temperature.

A statistical design has been based on a restricted number of 48 tires. The variations in the working conditions buffing, cementing, drying, degree of humidity, camelbacks, types of tires, pressures in the airbag and temperature in the mold, were limited to 13. From the adhesion values registered, most valuable information has been obtained on optimal conditions for the different operations. It is shown a.o. that fine buffing, spray cementing and a medium high pressure in the airbag are preferable, whereas characteristic differences exist between tires and also between camelbacks. The statistical results are discussed and explanations are given of the influence of variations in working conditions on bonding strength. The necessity to do further work is demonstrated.

**A Towing Device for Estimating Road Wear.** ***L. P. Gelinas and E. B. Storey (Polymer).*** The further development of experimental elastomers designed for tire tread service often depends upon an estimation of their wear resistance. Present laboratory abrasion tests do not provide a sufficiently reliable estimate of this characteristic, especially when the variable involves the fine structure or the composition of the polymer. A considerable delay and expense is involved in the preparation of sufficient material for a full-scale road test of an unproven elastomer.

In order to bridge this gap in a development program, a test has been investigated that involves towing a ¼-inch thick annulus of tread vulcanizate, supported on a two-inch diameter brass core, behind a passenger car over a highway. A test jig is described that permits a reference and an experimental wheel to be towed at 50 m.p.h. under a dead load that provides a pressure on the contact surface similar to that encountered in normal passenger car service. A cold styrene rubber HAF tread compound is employed as the reference vulcanizate and the two wheels are interchanged before the return journey in order to reduce miscellaneous side-to-side effects. A repetitive measurement of the circumference of the tow wheel allows an estimate of the wear to be made after 40 miles of highway travel.

The rate of wear may be adjusted by changing the angle between the plane of rotation of the tow wheel and the direction of travel of the towing vehicle. An angle of 7°.5 was found to produce a volume loss about equal to that encountered in normal passenger car service. Severity levels on either side of the normal wear range may be attained by varying the tow angle. A log-log plot of the volume loss per 1000 miles for the experimental and the reference vulcanizates at various tow angles provides a comparison of the wear characteristics over a range in severity levels.

The data from a number of road tests of 6.70-15 passenger car tires, and 10.00-20 truck tires are presented in which different levels of severity were obtained by either adjusting the load on the tire or employing various start-stop cycles. When the tread depth losses for these tires of different diameters were converted to volume loss per unit of contact area, a single log-log correlation between two tread vulcanizates is found which includes data obtained in the tow wheel test. This test method provides a means of estimating road wear performance at different severity levels from a six-ounce sample of an experimental elastomer.

**An Indoor Tester for Measuring Tire Treadwear.** ***G. G. Richey, J. Mandel and R. D. Stiehler (National Bureau of Standards).*** A description is given of the tire tester (U. S. Patent 2,766,618) recently developed at the National Bureau of Standards for measuring treadwear, including later modifications made as a result of experience in operating it. This tester consists of a rotating cylindrical roadway 1/60 miles in circumference and stations for testing 18 tires simultaneously. The tester accommodates both passenger car and truck tires ranging in size from 6.40-15 to 11.00-20. Load and inflation pressure are controlled independently for each tire. The speed can be varied up to 65 miles per hour. Results of studies made with this tester are presented, including correlation studies with treadwear tests made on the highway.

**Measurement of Tread Motion and Application to Tire Performance.** ***H. H. Vickers and S. B. Robison (Esso Research & Engineering).*** This study was made in an effort to analyze the phenomena of tire traction and tread wear. The kinematics of the wheel and the movements of a tire tread in rolling contact with the ground combined with the resistance of rubber to sliding are responsible for the rolling traction and the tread wear obtained with a pneumatic tire. Equipment described was devised to trace the movements of tread elements in rolling contact with a slippery surface. From such tracings, contour plots can be drawn to show the relative movement in the contact area. The ratio of static to dynamic areas in these contour plots was found to have a close relationship to the tractions obtained in driving tests on ice or snow.

Traction tests on lake ice also showed that static traction is two to four times greater than dynamic traction, or that obtained by a spinning wheel. This phenomenon is explained in terms of the kinematics of the wheel under torque. Incipient or complete rotation causes differential creep. This results in increased compression and load in the static area for more intimate contact with the ice. Similar differences prevail between a tire rolling under torque and a tire in locked wheel sliding. Longitudinal compression is considered an aid to traction, but detrimental to wear, while lateral movement is detrimental to both traction and wear. Tread wear is explained as being due to movement under horizontal compression at the leading surfaces rather than to movement under extension or release at the trailing edges of the contact patch. Movements in depth affect both traction and wear with a deformable material such as rubber, and there is a great need for a better understanding of the detailed mechanism of sliding friction and wear with these materials.

**International Road Testing of HAF and ISAF Blacks in Passenger Tires.** ***O. F. K. Bussemaker (N. V. Rubberfabriek Vredestein), E. M.***

***Dannenberg (Godfrey L. Cabot), C. Prat (Institut Francais du Caoutchouc), and H. Westlinning (Degussa).*** There are so many variables which have an effect on the rate of wear of a pneumatic tire that it is an impossible task to study any single variable independently of the others. On the other hand, the alternative technique of randomized testing would involve such a large number of tests that it is unwieldy. A compromise procedure is always employed in which a standard is included along with the experimental tires, and the results are expressed as a relative value with respect to the standard. These road tests are highly controlled insofar as the known variables are concerned.

Road tests of this type have been described in the published literature in recent years. They have established the need for better statistical design of test programs, careful statistical analysis of road test data, and the marked influence of road wear conditions or "severity" on the relative performance of different tread compounds. It has also been shown that "part" tread tires are more efficient than "whole" tread tires for establishing relative performance levels. There are, however, many questions which can only be resolved by the accumulation and analysis of more road test information.

The purpose of the present program was to establish the relative road wear performance of HAF and ISAF black-natural rubber passenger tire treads under a variety of test conditions. Accordingly, road and track tests were carried out in the United States, Great Britain, Germany, The Netherlands, and France. These tests have confirmed that the relative performance of the blacks in tire treads depends markedly on road test conditions. This factor can also be detected in comparing shoulder and center tire wear. A good correlation of results was obtained with both whole tread and part tread tires.

**The Role of Hysteresis in Tire Wear and Laboratory Abrasion. *A. Schallamach (British Rubber Producers Research Assoc.).*** Abrasion machines using slipping wheels (Akron abrader, Lambourn abrader) give reasonable correlation with tire wear under circumscribed conditions but generally fail in this respect when different polymers are compared. Similarly, abrasion data obtained in simple sliding of flat samples often bear no relation to either tire wear or slipping wheel abrasion. In order to elucidate these discrepancies, the mechanism of relative motion in the area of contact between a slipping wheel and the track has been investigated and expressions have been derived for the abrasion occurring there. It has been found that this wear depends not only on the actual abrasion resistance of the material but also pronouncedly on its elastic properties. Of particular importance and interest is the influence of hysteresis. It is shown that, other things being equal, abrasion of a slipping wheel will decrease with increasing hysteresis of the wheel.

Various predictions of the theory are in satisfactory agreement with experimental results, and the relation between hysteresis and wear is demonstrated by laboratory experiments. Lack of correlation between road wear data and laboratory data on slipping wheels is seen to derive from the fact that the mechanical properties of a tire are, in contrast to solid test pieces, only in part determined by the tread compound.

**A Theory of the Abrasion of Rubber. *F. W. Boggs (U. S. Rubber).*** When one solid slides over another two effects are observed: frictional forces appear and the solids are worn away. Despite their great technical importance, neither friction nor abrasion is well understood. In the case of friction between dry metals, as in the bearings of unlubricated machinery, bearing and journal are similar and both are subject to wear. When rubber slides over an abrasive surface, however, only the rubber is lost. At the same time, because rubber is incompressible, the resulting equations of elasticity are greatly simplified. Consequently a theoretical study of rubber abrasion is simpler than that of other solids.

If the friction coefficient of rubber is measured and plotted in terms of dimensionless variables, then a universal curve is obtained which is found valid for a wide variety of rubbers. This curve rises almost linearly for small slips; then it breaks sharply, and at this point abrasion increases greatly. Elasticity theory shows that at low slips the passage of rubber over an abrasive surface is a steady state phenomenon but that at high slips this is no longer possible; instead, the deformations become very large. This can account for the break in the friction coefficient and for the consequent loss through abrasion.

## Wednesday, November 11

### Morning Program

Advances in Test Methods

**Micro-Hardness and Micro-Rebound Measurements. *S. Oberto (Pirelli).*** Small scale testing methods are of great value especially for vulcanizate samples cut out of finished articles; they have obvious shortcomings, but sometimes also advantages, even in accuracy. Among these testing methods most important for the significance of the parameters and frequency of use are those intended to determine elastic modulus in its conservative and dissipative components.

For conservative or normal modulus an apparatus, called "microdurometer," was previously constructed; this is a compact instrument which allows easy measurements of the ISO rubber hardness on samples having a thickness down to 1 mm. Proceeding further it has been possible to to develop a "picodurometer" with an indentor of about 0.2 mm diameter and weighing 0.1g electromagnetically raised, where readings are taken by an optical interference method. Its use is somewhat more elaborate, but with it, it has been possible to measure hardness on samples of a few cubic millimeters, including rubber in sections of rubberized fabric, and also to detect surface hardening due to light or other treatments.

For hysteresis or dissipative modulus, attention has been directed towards methods employing elastic rebound. A "microrebound" apparatus has been developed and built for current use, intending not only to test thinner samples, down to 1.5 mm, but also to approach conditions in which reduction of parasitic energy losses increases the accuracy. The apparatus is substantially a pendulum with a mass of 80 g and an impact speed of 0.05 m/s; it is electomagnetically released and its rebound is read by means of the persistent luminescence of a phosphor covered screen; the sample is sucked on a stand thermostatized by liquid circulation. Results show very good comparison with the best of other pendulums.

**Micro-Hardness Testing—Its Possibilities and Limitations. *A. L. Soden and J. R. Scott (Research Association of the British Rubber Manufacturers).*** The need to test small awkwardly shaped rubber articles, which cannot be tested by normal methods, has led to the development of a scaled-down "micro" test for hardness. Attention is drawn to the mechanical problems that arise in devising such a micro test, especially those associated with friction in the moving parts and with the measurement of the very small movements of the indentor; the various ways in which these problems have been solved are described. The results of experimental work are presented to show the equivalence in readings between the micro and the normal (macro) test, the reproducibility of micro test results, and the influence of test piece dimensions, and on the use of a foot on the instrument as specified in ISO Recommendation R.48 for the normal hardness test. Attention is drawn in particular to the influence of the dimensions of the rubber tested and the limitations which this imposes on obtaining results agreeing strictly with those of the macro test.

**New Artificial Weathering Methods. *G. F. Bush (G. F. Bush Associates).*** After a brief introductory discussion of the general weathering effect at the earth's surface on everyday materials, including rubber and

rubberlike materials, the basic requirements of an idealized artificial weathering method are discussed in detail in terms of parameters of sunlight, moisture (including rain), temperature, gases, magnetism, radiation, dust and wind. The practical realization of a method introduces a great variety of essential topics, most of which are discussed in detail under "Concepts," "Parameter Limitations," "Apparatus," and "Evaluation."

Included among these topics is new information on the following: (1) Comparison of the concepts of total exposure and total time of exposure, e.g., the latter includes false assumptions of constant rates of the parameter (irradiation, concentration, voltage supply, etc.) and this introduces serious errors while the former concept accommodates even widely variable rates without error. (2) Reliability of reproducibility. (3) Air moisture as a new function of sunshine and temperature. (4) Effects of rain, gases, radiation, and dust. (5) New improvements related to basic parameters, e.g., in synthetic sunlight spectral distribution, accurate control of preset humidity, preset exposure patterns including day-night sequences; and various rain-dry programs. (6) Effects of various parameter groups, e.g., with and without controlled humidity, rain, etc. (7) Weathering evaluation, subjective and objective, by various types of instruments, standard sets of samples and photos, etc.; the new Fractional Fading rule. (8) Essentials of available apparatus for general and specific uses, including artificial sunlight sources. (9) Brief discussion of standard domestic and foreign light-fastness tests including the 1958 ISO. Basic references in the bibliography include fifty-six since 1955, some as private communications from abroad.

**The Natural and Accelerated Ozone Aging of Elastomer Compounds.** ***M. M. Lowman (Goodyear) and H. P. Miller (Goodrich).*** After World War II it soon became apparent that cracking due to ozone attack was taking an unusual toll on elastomeric products. The reasons for this sudden serious appearance would make many pages of interesting study and comments and may have been both physical and psychological. This paper, however, deals with the actions taken by users and vendors, together in ASTM and SAE committees, to develop testing standards whereby the resistance of elastomer compound could be evaluated.

Since the failures occurred outdoors, the first tests were outdoor exposures. Standard dimensions of the sample and standard mounting mandrels were developed to insure uniform strain on the sample. The handling of the samples in the unvulcanized and vulcanized state and the method of exposure were developed. A rating system was developed using for standards 2X photographs. A quality retention system was developed. The results of outdoor exposure in various places in the United States are given.

An effort was made to accelerate this cracking in an ozone chamber. The results were not reproducible between laboratories. It is shown where much closer agreement between laboratories is now being reached than at the start of the program. This is due to higher air velocity through the chambers, a better realization of the importance of the time on the mandrel before testing, the effects of crystallization of the samples, proper handling of the sample during aging on the mandrel before exposure, and clarification of the rating standards and their method of use.

Considerable progress has been made in the last ten years. Methods have been established for determining natural and accelerated ozone resistance of elastomer vulcanizates. We would like to improve these. There is a need for a correlation of natural ozone aging with accelerated ozone aging. For this we need a standard unchanging weather. Perhaps somewhere in this world or out of it there is a standard weather for standard natural ozone aging.

**Viscosity and Relaxation Measurements on Crude Rubbers and Compounds.** ***S. Eccher (Pirelli Rubber Laboratories).*** A parallel plates shearing viscometer has been developed and constructed, where friction has been completely avoided with the use of a symmetrical sample and where the displacements of the movable plate are optically followed by a device which may read to 0.1 $\mu$m; this instrument is therefore very suitable for viscosity measurements at very low shear stresses, down to 100 N/m$^2$ (10$^3$ dyne/cm$^2$). A similar parallel plate device equipped for shear stress measurements has also been constructed; the forces are measured by a strain gage transducer and an electronic integrator gives the time integral of the stress, which is dimensionally homogeneous with and may be compared to viscosity. The instrument is used to measure the shear stress relaxation following an instantaneous step of shear strain.

With these instruments experimental work has been done on raw natural and synthetic rubber and their mixtures with various fillers and softeners at different mastications and temperatures. Lower limit viscosities were attained where behavior of materials has been found to be substantially Newtonian. Time integral of stress and limit viscosity give interesting information as to behavior of crude materials during plastic deformation which may take place during processing and in subsequent free recovery.

**Aging of Rubber Vulcanizates.** ***J. Mandel, F. L. Roth, M. N. Steel and R. D. Stiehler (National Bureau of Standards).*** An analysis of aging data in the literature and of measurements made at the National Bureau of Standards indicates that elongation at failure is the best of the tensile properties for characterizing the deterioration of rubber vulcanizates during storage at various temperatures. Elongation at failure decreases during aging for all types of rubber vulcanizates; whereas, tensile strength and modulus may increase, decrease or remain essentially unchanged. During most of the useful life of a rubber vulcanizate, ultimate elongation decreases approximately linearly with the square root of time. The square root relationship can be used to predict a minimum life for the rubber vulcanizate since the decrease in elongation after long periods of aging becomes less than would be inferred from this relationship. Measurements of ultimate elongation at two or more elevated temperatures makes possible an estimate of shelf life at room temperature.

**The Charles Goodyear Medal Lecture** of the Division of Rubber Chemistry, American Chemical Society, will be presented. The paper, entitled "People and the Banbury Mixer," will be delivered by 1959 Goodyear medalist, Dr. Fernley H. Banbury.

## Wednesday, November 11

### Afternoon Program

Session A—Test Methods
Session B—Classification
Session C—Statistical Methods

#### Session A

**Standards for Rubber Compounding.** ***F. L. Roth and R. D. Stiehler (National Bureau of Standards).*** The National Bureau of Standards has established 17 standard samples of ingredients used in rubber compounding, including three standard rubbers. This paper describes the procedures used for sampling and evaluating these standards. Some of the problems encountered in establishing them are presented.

**Sulfur Group Analysis in Natural Rubber Vulcanizates.** ***M. L. Studebaker and L. G. Nabors (Phillips Chemical).*** Our ideas on the nature of the crosslinks in sulfur-cured vulcanizates are largely based on the following types of information: (1) studies on model systems; (2) analyses for allyl sulfide by removal with methyl iodide; (3) stress relaxation as a function of temperature; (4) combined sulfur coupled with total crosslinks from swelling or modulus data; and (5) isotope exchange using $S^{35}$. This information generally indicates that the crosslinks are composed of mono-, di- and polysulfide linkages. To obtain additional insight into this problem, we have employed the very reactive reducing agent, lithium aluminum hydride.

In this paper data will be presented on some natural rubber gum and HAF-loaded compounds, containing 3 phr sulfur and 1 phr of three different accelerators. TMTD (sulfurless) cures will also be included. After extraction with chloroform and treatment with a 50:50 mixture of ether and concentrated hydrochloric acid followed by extraction with methanol, vacuum drying and swelling in dioxane, the samples were treated with lithium aluminum hydride and the quantities of sulfide sulfur and mercaptan formed were determined by potentiometric titration. When coupled with other analyses, these results provide useful information on the nature of the crosslinks.

**The Stress-Strain Behavior of Elastomers at Different Velocities of Deformation.** ***G. Fromandi, R. Ecker and W. Heideman (Farbenfabriken Bayer).*** In the mechanical-technological testing for the assessment and control of elastomers the one-point test is mostly sufficient, particularly when the mechanical, physical, and chemical values are already laid down by a comprehensive range of testing. But this procedure is insufficient for the development of new elastomers in order to classify them amongst the already known materials. For this purpose it is necessary to carry out testing on a large scale under a wide range of testing conditions. The most important parameters in the testing of elastomers are the following: the mechanical prestressing of the test specimens, the testing temperature, and the rate of deformation. The first two parameters have been dealt with in previous papers. The present paper deals with the influence of the rate of deformation during the static tensile test.

For this purpose a testing apparatus has been designed which is fitted with a device to exert the required force on the test specimens. The forces which cause deformation and the deformation are transmitted by means of an electronic transmitter to an oscillograph and recorded by a camera. The testing apparatus mentioned will be described in detail. A preliminary report shows by means of graphs the testing results obtained on various elastomers.

## Session B

**A Practical Method of Classifying All Elastomeric Vulcanizates.** ***N. L. Catton (DuPont), R. C. Edwards (Chrysler Engineering) and T. M. Loring (Michigan Precision Molded).*** The paper will present a discussion of a new system of coding and classifying *all* elastomeric vulcanizates. The complex problems facing the rubber and automotive industries dictated the need for an improved system that would be flexible enough to satisfy today's and provide for tomorrow's requirements. The importance of retaining the nomenclature advantages and experience gained with ASTM D735 is recognized. Any system to be acceptable must be flexible enough to accommodate future new elastomers, test requirements and methods of test, must supply guidance to the user in the selection of practical commercial compositions and restrict the inexperienced from specifying impossible and impractical combinations of physical properties. The resulting "Expanded Tabular System" provides a satisfactory answer to these needs.

The system provides a simple and flexible method of calling out various qualities and grades of elastomeric vulcanizates, based upon physical properties determined by specified standard methods of test. The proposed system is a single tabular presentation of values obtainable in practical commercial compositions. The nomenclature will provide for easy and practical call-out of quality and test conditions. The use of the system and its applicability to all branches of the rubber industry is considered. The flexibility and simplicity of the "Expanded Tabular System" will be stressed, as will the need for a uniform world-wide acceptable classification and coding system. The advantages of the "Expanded Tabular System" will be discussed, and it will be shown how the proposed system could be used on an international basis. The format is flexible enough to permit the use of either the British standard units or metric system units; and, if desirable, a master table could be prepared containing both units of measurement.

## Session C

**The Use of Regression Techniques in Elastomer Compounding.** ***P. F. Bertsch (DuPont).*** Several properties of elastomer compositions such as scorch resistance of the mixed compound and stress-strain characteristics of the vulcanizate are described as continuous mathematical functions of the ingredients and curing conditions. The specific relationships used are derived empirically from a small number of data points. Precise mathematical descriptions are developed from more complete data with the application of regression techniques. Statistical testing is then used to evaluate the adequacy of the relationships (or mathematical models) to fit all the data. When an empirically selected mathematical model is judged inadequately by the statistical test, it is discarded and another more appropriate one chosen.

This technique is applied to the complex problem of predicting the heat resistance of an elastomer at various elevated temperatures. This work shows the correlation between the compression set of unaged samples and the tensile strength or elongation of aged samples. Mathematical models are developed to describe these relationships more precisely because of their potential usefulness in assessing heat resistance without actually aging and testing.

The successful use of the regression technique depends upon a judicious choice of experimental points; a thorough study of the data generated, and the liberal use of a digital computer to perform the numerous and tedious calculations. These items are discussed in some detail. The practical value of this approach includes: (a) the ability to look at properties as they are simultaneously affected by changes in two, three or more variables permitting an over-all rather than piecemeal treatment of a problem; (b) the large output of information versus the number of experiments — an efficiency which thrives on a high number of variables; (c) the versatility inherent in working with mathematics—permitting, for example, the calculation of maxima, minima, restricted maxima, etc.

**Modern Quality Control.** ***S. Collier (Johns-Manville).*** We are all aware that since World War II we have witnessed a steady increase in prices. Throughout the war years, because of the need for large quantities of finished goods, it was often necessary to reformulate and revise methods of manufacture in order to meet the demands. During the transition period from war to peace time production, when supply could not meet demands, there was no comparable increase in quality for the increase in price. However, when we changed from a seller's to a buyer's market, the picture rapidly changed. Customers became quality conscious and have continually demanded better product quality for their inflated dollar.

As might be expected, manufacturing costs have similarly risen due to increased costs of raw materials, labor, taxes, etc., and in order to have a satisfactory profit, it has been necessary for management to utilize every means possible to keep their costs down. It seems to be a paradox that we are expected to improve the quality of our products, but at the same time, to reduce the costs of quality control and inspection. There have been several means by which this has been accomplished: (1) by installation of incentive plans; (2) by automation of the process; (3) by application of various statistical techniques; (4) by direct appeal to the workmen to do a better quality job. The Quality Control Department has been most concerned with the latter two as they are part of our direct responsibility.

The two most common statistical techniques are process control charts and sampling plans which are outlined in the Johns-Manville color film entitled, "Modern Quality Control." This film is used for the training and education of our personnel in these techniques.

Perhaps the most important of any of the other approaches is that of appeal to the workmen to produce quality goods. There must be a feeling of quality consciousness throughout the organization, else the other approaches

will follow short of their objectives. The spirit of quality consciousness, while present in every organization, needs stimulation if it is to flourish. To do this, we need the help and cooperation of all members of the organization from top management to the production worker. There must be a continual training and educational program to constantly bring to the attention of all concerned the importance of quality. Meetings, films, posters and exhibits all aid in keeping the spark alive.

Many case histories can be cited featuring the success of these various approaches and such are in existence for all types of industry. Since your interests are primarily concerned with the the rubber industry, we have a very good basic application demonstrating both process control and worker cooperation which resulted in a marked improvement in quality and also appreciable savings.

## Wednesday, November 11

### Concurrent Afternoon Program

### Theory

**Measurement and Interpretation of the Rate of Volume Swell and Equilibrium Volume Swell in Cross-Linked Networks.** ***D. J. Buckley and M. Berger (Esso Research & Engineering).*** The swelling method involving the amount of solvent imbibed by a cross-linked network at equilibrium has been used extensively for numerous purposes. This method has been used to determine interaction coefficients, molecular weights of chains between crosslinks and to study the crosslinking process and the nature of reinforcement. The standard method consists of allowing a sample to swell to equilibrium in some solvent and then determine the amount of solvent imbibed gravimetrically.

An optical method is described which not only greatly simplifies obtaining data at equilibrium but also allows taking of data during the dynamic process of swelling. The method consists of interposing a sample of elastomer in a glass cell containing a particular solvent in the path of a light beam. The light which is not intercepted by the sample passes through a lens system into a phototube. The output of the phototube is recorded. As the sample imbibes solvent, its increase of area intercepts more light resulting in changes in the phototube output. Samples are found to swell isotropically and thus area increase can be converted to volume increase.

Experimental considerations and limitations are discussed along with representative curves of the complete swelling history of vulcanizates up to and including equilibrium. These vulcanizates are considered with respect to the crosslink density achieved by a number of vulcanizing systems. Carbon black and mineral pigment compositions are analyzed relative to the nature of reinforcement. A number of solvents are employed which represent a range of interaction coefficients for the polymers under study. The swelling process is discussed as a diffusion problem wherein the diffusion coefficient is concentration dependent.

**Longitudinal Tearing of Vulcanizates in Extension: II — Tests of Various Elastomers in a Limited Range of Temperature and Speed.** ***R. Chasset and P. Thirion (Institut Francais du Caoutchouc).*** In a previous article, the authors described a method of measuring longitudinal tear resistance of stretched rubber. By this means, the instantaneous transverse force is determined which is required to initiate—with the aid of two metal loops arranged at the top of the cut—a longitudinal tear in a partially split sample ("trouser" type) subjected to static extension. This test was conducted on various elastomers in order to explain the effects of the fibrous structures frequently involved when the only force applied to the sample is the tearing force itself. Examined were: natural rubber, cold styrene-butadiene rubber (Krylene) Neoprene W, a butyl rubber (Polysar 301) and a nitrile rubber (Hycar 1042), either as pure gum compounds or as reinforced compounds (MPC, ISAF blacks; Hi-Sil 233°, colloidal silica).

In the range of temperatures (20° to 60°C.) and speed (separation of loops 5cm./min.) studied, longitudinal tearing of natural rubber vulcanizates presents peculiar characteristics, as compared with that of the synthetic rubbers tested. The manner of tearing and the level of the critical force at the instant when tear growth begins, in particular, are much more influenced by the amount of static elongation the sample has undergone. Thus in natural rubber with elongation under 70-80 per cent, tearing is seen to occur suddenly as if the fibers ruptured perpendicularly to their axis, whereas above 140 per cent, tearing progresses slowly as though the fibers separated laterally. On the other hand in synthetic rubbers tearing is related to a process of plastic flowing, whatever the elongation of the sample may be. Finally it was noted that the way in which reinforced compounds vulcanized with a peroxide tear, is distinctly different from those vulcanized with sulfur and an accelerator.

At present it is difficult to interpret the over-all results obtained. However, crystallization does not seem to play a decisive part in the fibrous tearing of natural rubber, indeed: (1) At 60°C., neither the tearing behavior of natural rubber nor the levels of critical force differ much from those observed at 20°C. (2) Elastomers capable also of crystallizing by stretching, like neoprene or butyl rubber, show the same amorphous tearing characteristics as a non-crystallizable elastomer like styrene rubber.

With the reservation of verification based on other rheological properties, optical or electrical, of reinforced vulcanizates, the preceding tearing methods suggest the following hypothesis respecting the nature of the structures liable for the improvement of their tear resistance. The constituent elements of the fibers might be agglomerates of filler particles including little rubber, the differences observed in accordance with the nature of the elastomers could then be due to the rheological behavior of the agglomerates, being more elastic in natural rubber mixes and more plastic in synthetic rubber mixes.

**The Measurement of Flow and Slip Velocity with the Shearing Disc Viscometer.** ***M. Mooney (U. S. Rubber).*** If a Mooney shearing disc viscometer is fitted with a multi-speed drive and an extra rotor with a smooth surface, it is possible to compute from experimental data both the rate of shear of the test material and its velocity of slip on the smooth rotor surface, each as a function of the shear stress. The rheometric theory for the computations assumes that the exact flow and slip functions can be adequately approximated by power expression of the form $g = f\tau^n$, and $v = s\tau^p$, where g is the rate of shear, v the slip velocity, $\tau$ the shearing stress, and f, n, s, and p are material constants. The constants s and p are characteristic not of the test material alone, but of the combination of the test material and the rotor surface. A graphical procedure for obtaining the flow curve shows the slip velocity of pale crepe on a Teflon coated smooth rotor at 100°C.

**Response of an Elastomer to Any Forcing Function.** ***M. Berger (Esso Research & Engineering).*** It is well established that if the response of a system to a step function is known then the system's response to any forcing funcion can be predicted. If the system is linear, then Borel's or the convolution integral can be used. For non-linear systems, other techniques must be employed. In this work, these principles are used for the study of the mechanical behavior of elastomers. A device for applying a step function in stress and detecting the strain response has been designed. From the results of a single experiment with this equipment, it is possible to calculate the response of the elastomer over a wide frequency range. In addition, the response of the elastomer to any selected stress, such as may be characteristic of a service application, can be found. Typical results for vulcanizates of butyl, styrene rubber, and natural rubber are discussed.

This technique permits a characterization of dynamic properties over a wide frequency range. Since the method also provides a prediction of response to selected types of stresses, it is apparent that it is an excellent tool for applicational research on elastomers The method discussed up to this point is based on an assumption of linearity in the elastomeric dynamic system. A further detailed technique, involving use of an analog computed, has no restrictions relative to non-linearities. In essence, an analog is built up such that the response of the analog to a step function is the same as the response of an elastomer. The components of the analog bear a direct relationship to the components of the elastomer which contribute to dynamic behavior. This approach in addition to providing response information gives insight into the nature of the viscoelastic behavior of polymers.

**Some Statistical Consideration Underlying Molecular Theories of Rubber Elasticity.** ***Jacob Mazur and Turner Alfrey, Jr. (Dow Chemical).*** This paper does not introduce a new molecular theory of rubber elasticity, but rather develops some previously unnoticed statistical considerations basic to any such theory. A real vulcanized rubber network is a topologically complex structure, consisting of a series of mesh-points connected by flexible chains. The configurational changes on the molecular level which accompany a macroscopic elastic deformation are subject to certain strong restrictions; e.g., preservation of the topology of the network.

Consequently, the individual chains of the network are far from being independent statistical elements. Such a real network can be partially simulated by various idealized networks consisting of independent chains connected into simple topological structures. Each individual chain is then characterized by a chain-end distribution function, w(r), which not only reflects the internal structure of the chain but also simulates in some way the effects of the network restrictions.

The first part of this paper deals with one-dimensional model systems; various series-parallel arrangements of "independent" chains, and a wide range of chain-end distribution w(x), are analyzed. A probability function W(X) is derived for the vectorial separation between *terminal* mesh-points of the network. Next, $X$ is constrained to a fixed value, and a conditioned probability function $X(x)$ is derived for the individual chains in a deformed network. It is possible to draw rigorous conclusions concerning the conditions required for an affine transformation of network points, or for a shift of distribution function without broadening, etc.

The above treatment is extended to two-dimensional arrays of chains and mesh-points, using the more tractable forms for w(r). In the case where the distribution functions for the individual chains are displaced Gaussian functions, a mathematical analogy is developed which permits a network of flexible chains to be replaced by an "equivalent" electrical network.

## Thursday, November 12

### Morning Program

Elastomer Reinforcement

**Reinforcement of Rubber by Fillers.** ***E. Andrews, L. Mullin and N. R. Tobin (British Rubber Producers Research Assoc.).*** The relative adhesion between rubber and fillers is examined in an electron microscope study of ruptured surfaces, and the effect of dispersion procedures and promoters described. It is shown that rupture of rubber vulcanizates occurs preferentially at the interface between rubber and filler particles. One source of the increase in strength which results from the incorporation of reinforcing fillers is traced to the resultant multiple breakdown at the surface of filler particles. This breakdown involves a dissipation of energy and results in a roughening of the ruptured surfaces. Two other important characteristics of filler reinforced rubbers, viz, their large hysteresis and their softening during stretching, are examined in light of these observations and a consistent picture of the role of fillers in reinforcement is proposed.

**Elastomer—Filler Interactions.** ***J. P. Berry, P. J. Cayre and M. Morton (University of Akron).*** It has been found by several investigators in recent years that either cold milling or heating of carbon black-rubber mixtures results in the formation of some "bound rubber" or "carbon gel." There is evidence that free radicals are involved in these processes.

New data have been obtained which show that heating milled carbon black-styrene rubber mixtures, at vulcanization temperatures, results in an increase both in bound rubber and in degree of crosslinking, especially the latter. This effect of heating after milling is much larger than either milling or heating alone. There are indications that the free radicals formed during the milling are more or less "frozen" by the high viscosity of the matrix, but react quickly at higher temperature to add more bound rubber, and especially to crosslink the bound rubber about ten times more than either of the separate treatments.

However, it was found that the degree of crosslinking introduced by sulfur vulcanization, in presence of a HAF black, is about ten times as great as that produced by milling and heating alone. Hence the carbon black-rubber interaction per se does not contribute much to the number of crosslinks in the vulcanizate. It should be noted, however, that the crosslinks introduced by sulfur vulcanization and by milling black-rubber mixtures are additive. Some correlations are shown between stress-strain behavior and the proportion of crosslinks due to black-rubber interaction.

**Interactions of Hydrocarbons and Powders.** ***W. C. Wake (Research Association of the British Rubber Manufacturers).*** This paper is implicitly concerned with the reinforcement of rubber and the differences between various powders in their reinforcing effect. Hydrocarbons of low molecular weight have been used as models for rubber and the energy of adsorption onto a range of powders considered. The powders, carbon black, silion, barytes and whiting, show a range of adsorptive behavior due to their neutral or ionic crystal structure interacting with the polarization properties of the liquids used. The results have been obtained by direct wetting and refer to the integral heat of adsorption. It is quite clearly shown that, for unit surface area, the total energy of adsorption of a liquid containing a polarizable double bond is far higher onto an ionic crystal such as barytes that it is onto carbon black, so that if high adhesion of the liquid to the powder were an important factor in reinforcement, ionic powders would be desirable.

Part of the paper considers the differentiation of the mobile from the localized ($\alpha$ angmuir) model of adsorption. The available data enable entropy calculation to be made for certain hydrocarbons adsorbed onto carbon black. The calculated entropy change agrees well with that predicted by theoretical calculation for mobile rather than localized site adsorption. These results, together with the total energies, suggest the superiority of carbon black is associated not only with its ability to accent free radicals as has been pointed out elsewhere, but also with the relatively low total energy of adsorption permitting the adsorbed molecule to retain mobility on the surface.

**Mechanico-Chemical Reactions Leading to Reinforcement in Rubbers.** ***R. J. Ceresa (National College of Rubber Technology).*** A short survey of the polymer polymeric free radical processes induced by the mastication of (1) rubbers with carbon black; (2) mixtures of rubbers; and (3) rubbers swollen with free radical polymerisable olefinic monomers. The interaction of ionic materials of the general structure $MX_n$, e.g., aluminum isopropoxide, with rubbers during mastication to give crosslinking and consequent gel content. The postulation of an ionic mechanism to account for the crosslinking which is

further extended to cover the mechanism of reinforcement of rubbers by phenolic resins, epoxy resins, and gelation in rubbers with other additives during mastication. The presentation of physical testing data to illusrate the reinforcing effect of gelation prior to vulcanization.

**Oxidation of Hevea Vulcanizates Containing Carbon Black.** ***E. M. Bevilacqua (U. S. Rubber).*** The detailed investigation of the mechanism of degradation of polyisoprene by oxygen has now been extended to a study of the effect of carbon black. Since previous work has shown that the mechanism is not affected by the nature of the crosslink, a simple peroxide cure was used in the experiments described in this report. It is found that all of the low molecular weight products which are known to be an index of hydrocarbon scission reactions are formed in a stock containing 50 parts of MPC. The ratios of the quantities of these products and to oxygen consumed are identical within experimental error with those observed for rubber containing no carbon black whether vulcanized or not. From this evidence it can be concluded that carbon black has no effect on the over-all mechanism of degradation of the polymer except on rate.

It appears possible to explain the the effect of carbon black on the rate of degradation of the polymer by oxygen by assuming simply that it is a moderately good thermal antioxidant. Upon comparison of the results of swelling and solubility measurements with the conclusions from the chemical evidence concerning the degradation reaction, it appears that a way has been achieved to make an absolute calibration of crosslink density in a network containing carbon black.

**Swell Resistance of Polymer Filler Systems to Boiling Water.** ***S. Palinchak and W. J. Mueller (Battelle Memorial Institute).*** Rubber vulcanizates used as gaskets, which will be exposed to steam, must be resistant to water at elevated temperatures if they are to function properly. Excessive water absorption results in a high degree of swelling and loss of physical properties. Data in the literature on water absorption and swelling of polymer-filler systems are very limited, with only a few publications dealing directly with this subject. Therefore, this study was undertaken as a means of systematically collecting and correlating data.

In the program, the swelling and and water absorption of a large variety of vulcanizates were determined in boiling water for exposure periods up to 168 hours. It was found that (1) the initial rate of water absorption; (2) the time required to reach equilibrium abexposure tests.

sorption; and (3) the maximum amount of water absorption was different for each polymer and was greatly affected by the filled used. Vulcanizates based on polymers, such as Butyl 325 and Styrene rubber-1503, and filled with carbon black, Cab-O-Sil, and Calcene NC had low water absorption. On the other hand, polar polymers, such as nitrile and neoprene, or fillers, such as magnesium oxide and Silene EF, gave vulcanizates which continued to swell even after 168 hours exposure to boiling water.

This work indicates (1) polymer-filler systems which can be used for minimum swelling and water absorption in boiling water; (2) systems which must be carefully avoided for use with boiling water or steam; and (3) the theoretical aspects of the results and a possible approach for predicting water-absorption characteristics for various polymer-filler systems.

**Selection of Process and Extender Oils with Minimum Staining Characteristics for Use in Rubber.** ***J. S. Sweeley, J. B. Ziegler, R. W. King and S. S. Kurtz, Jr. (Sun Oil).*** It has been shown by previous references (Borg et al) that process oils low in aromatic content (less than 40 per cent aromatic molecules) are desirable for use as plasticizers and extenders in light colored rubber stocks. The present paper expresses the desirable range of aromatic content in terms of aromatic carbons rather than aromatic molecules since there is good reason to believe that this is the more reliable basis for classifying oils for this use. Also carbon type data cost less to get than molecular type composition data. The aromatic part of the molecule is the part which is mainly concerned with light adsorption and, in general, with degradative processes.

A table of data is presented giving physical properties, molecular type composition, and carbon type composition for about 25 oils which have been considered for use in light colored rubber. A graph is presented showing the molecular weight and probable volatilities of those oils. Carbon type composition is also presented graphically. Data are presented showing the relation between position on the carbon type composition graph and the color stability in a quantitative light reflection test.

These data include that preferred oils for nonstaining use should have 6 per cent or less aromatic carbons, although oils up to 16 per cent aromatic carbons may be used for this type of application, when compatability or processibility are considered important. Since the per cent aromatic carbons can be easily derived from simple physical property measurements, this system of selecting oils is suitable for use in practical compounding. Data are also presented comparing indoor and outdoor

## Thursday, November 12

### Concurrent Morning Program

Natural Rubber and Latex

**Preservation of Natural Rubber Latex in the Field.** ***J. S. Lowe (Dunlop Malayan Estates).*** It is now generally recognized that bacteria and bacterial enzymes are of great importance in controlling the properties of natural rubber latex concentrate and, in particular, in controlling the changes in properties that take pace between the time of concentration in the tropics and consumption in the United States, United Kingdom and elsewhere. Bacterial enzymes are of particular importance when dealing with large bulks of latex. A large bulk of latex will contain latex from a wide area and from a large number of clonal varieties, and effects attributable to these variables will be largely absent.

The addition of ammonia to latex suppresses the activity of the bacteria. In an earlier paper, the author described the conditions required to activate the bacterial enzymes present in the latex after concentration and the resulting alterations in the properties of the latex. These changes are normally followed by measuring the evolution of the volatile fatty acid content of the concentrate. The present paper describes the effect of different field conditions in influencing the number of bacteria in the concentrate and the evolution of its properties.

It touches on such points as the fact that small quantities of ammonia encourage rather than suppress bacterial growth; the need for early collection of the latex and careful supervision of collection routines in the field. The effect of such factors as the density of the canopy of the rubber trees is also considered. A heavy canopy affects the temperature of the latex in the tapping cup and can, therefore, have a marked effect on the rate of bacterial prolifieration prior to collection. The bacterial activity is also controlled by the amount of substrate present. The practical implications of this point in regard to latex processing are discussed.

**Modern Large Scale Production of Hevea Rubber and Hevea Latex Concentrate.** ***G. Verhaar (Firestone Plantations).*** The Firestone plantations in Liberia cover an area of 71,000 acres of producing rubber and 15,000 acres of immature rubber. Annual production is now at the rate of 85,000,000 pounds; in addition, over 11,000,000 pounds of locally purchased rubber is processed and shipped. The Harbel area is the largest continuous plantation unit in the world. At present, eleven different grades of rubber are produced including a "tailor - made" rubber with high physical properties.

First quality crepe is produced by blending sulfited field latex in lots of 7000 gallons, coagulating in 175 gallon skids using a mono-rail system, milling and drying at 110°F. The rubber produced from ammoniated centrifuge skim is chemically purified. The process consists in clarifying the skim to remove copper, allowing it to coagulate spontaneously, milling it to a crumb, treating it successively with saturated lime water and a caustic solution, followed by thorough rinsing. This gives a clean, bright colored, sweet smelling dry rubber with a nitrogen content, acetone extract, ash and rate of cure only slightly higher than regular first quality pale crepe.

**Recent Developments in the Production and Processing of Natural Rubber in Malaya.** ***J. E. Morris and B. C. Sekhar (Rubber Research Institute of Malaya).*** The past decade has brought many changes in the Malayan rubber industry and has been characterized by the vigorous replanting, maximum economic exploitation of estates and smallholdings, and development of new forms of natural rubber. The differences between the latex and dry rubber obtained from young and old, clonal and seedling, trees by normal tapping and by the newer high intensity tapping, high level tapping and tapping with the use of yield stimulants are presented. The general effects of these changes on the properties of Malayan rubbers are discussed.

The main contaminants of natural rubber are described together with results from experiments designed to give improved quality rubbers. Removal of certain non-rubbers from natural rubber or modification of the non-rubbers has given commercially valuable products. Details of these processes are given, particularly in respect to the preparation of purified crepes and the production of technically classified rubbers. Field latex variation has its effect on the production of latex concentrates and especially on low ammonia preserved types. Examples are given of the recent commercial developments of low ammonia latices which now constitute an appreciable and increasing proportion of the latex concentrate produced.

Production of the recently developed superior processing rubbers in the form of crepe, air dried sheet and ribbed smoked sheet has reached 2,000 tons per annum. A new low grade type known as SP Brown and a versatile processing aid known as SP-90 are now described. Details of recent research work on latex which may well influence commercial processing in the future are given. In particular the mechanism of rubber oxidation during processing and storage and the possibilities of combatting such deterioration are suggested. Variation in oxygen reactivity of the polyisoprene contained in different clonal field latices are described.

The presence of reactive "amine" type reduction activators has been established in field latices. These give a new insight into some of the problems of pale crepe production. Due to the reactivity of the rubber in fresh field latex and the presence of reactive substances the properties of modified rubbers prepared from them are substantially different from those prepared from preserved latex. This is discussed with particular reference to thiol acid rubbers and graft rubbers.

**Towards Standardization of Natural Rubber — Present Trends.** ***M. Liponski and Vu-Dinh-Do (Institut des Recherches sur le Caoutchouc au Viet-Nam).*** Coagulation in partitioned tanks, still the general practice on plantations, causes variability in the mechanical properties of the rubber of which the prevailing commercial classifications, based solely on appearance, gives no clear indication. Consequently, a first effort was made to put on the market rubbers technically classified on the basis of their vulcanizing characteristics. (TCR — Technically Classified Rubber). If it is desired to adapt coagulation conditions to the different types of latices, so as to produce a rubber with constant vulcanization characteristics, it is found that at times this technical improvement can not be achieved without detriment to outward appearance—which shows how irrational present commercial grading is.

To ensure proper manufacture, it has proved necessary to change the coagulation method radically so as to ensure preparation of a product which would be judged only by technological standards, as—for that matter, synthetic rubber is. The production of two types has thus been developed on pilot plant scale. C 57 Standard, with the properties of smoked or dried sheet, corresponds to blue circle TCR and is obtained by a continuous process involving controlled, automatic acidification, thermo-coagulation and granulation of the coagulum. F 58 Standard, which looks like a very pale crepe, is made by a flocculation process which also permits continuous operation. The two processes not only make it possible to ensure constant properties but also to improve them, thanks to control of coagulation by means of the pH-meter and more efficient adjustment of drying conditions.

**Physiology as a Help to Improvement of Yield of Hevea.** ***J. LeBras (Institut Francais du Caoutchouc).*** This paper presents a general outline of the research carried out at the Rubber Research Institute in Indochina, aimed at a better understanding of certain physiological factors which affect the yield of Hevea rubbers. The starting point was the hypothesis that a part of the substances which it is assumed insure the biosynthesis of rubber, is more or less carried along in the flow of latex; the cells therefore have to synthesize these substances after each tapping, and the materials which are in danger of being most deficient for this reconstitution—if the plant is adequately provided with nitrogen, phosphorus and potassium—are oligo-elements. This led to a first experimental project based on the direct introduction into the tree, by injection into the wood, of products whose action it was desired to study. The most active proved to be copper salts, especially the sulfate, injection of which resulted in a marked increase in latex secretion from Hevea rubbers under normal conditions of exploitation, and that for two or three months.

Then research was extended to the principal mineral elements utilized by the plants and their variations in leaves and in the latex during the year and in relation to the plant material. After thousands of samples had been analyzed, certain laws emerged which govern the mineral metabolism of Hevea and to deduce from them the equilibria which must be ensured in order that the assimilation and utilization of these elements may take place under the best conditions. In this way, what is called the "physiological diagnosis" can be established for a planting material, making it possible to plan a more rational exploitation of Hevea rubber and to insure optimum output by determining the most suitable fertilizers and injections. This method is now being used successfully by the leading plantations in Viet-Nam and Cambodia.

## Thursday, November 12

### Afternoon Program

#### Vulcanization

**Properties of Compounds Relative to Vulcanization.** ***J. H. Gifford (Witco Chemical).*** A study of tread type compounds indicates a definite relationship exists between free sulfur and state of cure as measured by optimum physical properties. For smoked sheet tread, this falls on the hyperbolic curve.

$$625\ (0.6\text{—Free Sulfur})^2\text{—}0.02\ (280\ \text{—}\ \text{Temp. °F.})^2 = 1$$

Where T = degrees Fahrenheit

For styrene rubber—1500 tread, the relationship is a parabolic curve.

$$.04\ (T - 303)^2 - 1100\ (\text{Free Sulfur} - 0.15) = 0$$

Where T = degrees Fahrenheit

For a tread composed of 80 per cent smoked sheets—20 per cent styrene rubber—1500, free sulfur for vulcanizates of optimum physical properties appears to be around 0.3 per cent for all vulcanizing temperatures except for heat build up. This property shows a minimum free sulfur at 260°F. which is the

opposite of Smoked Sheets tread heat build up which has a maximum free sulfur at 280°F. cure. This study indicates that the practice of approximating equivalent cures by doubling the time for each 18°F. decrease in vulcanizing temperature is grossly inaccurate. The data show that for smoked sheets tread, time and temperature are related as follows:

220 Log Log Time + Temp. °F. = 326

For styrene-butadiene—1500 tread, the relationship is

70 Log Time + Temp. °F. = 432

For 80% smoked sheets—20% styrene-butadiene 1500 tread, the relationship is

60 Log Time + Temp. °F = 400

Examination of data shows a progressive decrease in optimum physical properties of smoked sheets tread as vulcanizing temperatures are raised above 260°F. For styrene rubber—1500 tread, optimum physical properties are not affected as vulcanizing temperatures vary from 240°F. to 340°F. The 80 per cent smoked sheets—20 per cent styrene rubber—1500 tread reacts differently from both smoked sheets and styrene rubber—1500 tread compounds. At high vulcanizing temperatures, there is only slight loss in tensile, but loss in modulus is almost twice that of smoked sheets tread. There is no change of heat build up properties at high vulcanizing temperatures, which is in contrast to an appreciable increase of heat build up properties of smoked sheets tread as vulcanizing temperature is increased. It is suggested that in conjunction with thermocouple data, the above free sulfur—vulcanizing temperature relationships can be used to measure the state of cure of a tire tread.

**Estimation of State of Cure of Elastomers by Means of Radioactive Sulfur.** ***H. L. Pederson (Nordiske Kabel-OG Traadfabriker).*** Estimation of the state of cure of elastomers by means of radioactive sulfur S—35. The introduction of S—35 having a specific activity of 0, 2—0, 4 mC/g followed by an exhaustive extraction with acetone allows a determination of bound sulfur calculated as the ratio of the activities of the sample before and after extraction. Using an 1 inch circular disc, 0, 8 mm thick, the "apparent bound sulfur" can be determined with an standard deviation of about 5 per cent. The method is of special value in connection with polymers not easily dissolved in nitric acid as neoprene, styrene rubber, butyl and nitrile.

According to Dogadkin the labeled samples are treated with a benzene solution of S—32 and the exchange of sulfur is determined as a decrease of activity. Further a treatment with solution of sulfur donors, TMT and Tetrone, in acetone solution at the boiling point was investigated. Finally the reaction with methyliodide (Meyer and Selker) has been studied boiling another set of extracted samples in an 1 + 2 mixture of $CH_3I$ + acetone. For different curing times at constant temperatures using different polymers and curing systems a stability pattern for the sulfur bond is revealed which in turn is compared with the aging stability of the systems involved. Due to serious experimental difficulties the presented results are preliminary and not quite consistent in all cases. The S—32 exchange and the $CH_3J$ — Thiuram reaction do not follow the same trend.

**Chemical Interpretation of Dicumyl Peroxide Vulcanization.** ***L. O. Amberg and W. D. Willis (Hercules Powder).*** Dicumyl peroxide (a, a-dimethylbenzyl peroxide) thermally decomposes with formation of free radicals. In certain environments it may decompose through an ionic cleavage reaction. The free radicals will vulcanize a variety of polymers; the cleavage products will not. In neutral or alkaline environments, cumyloxy (a, a-dimethylbenzyloxy) radicals form by a temperature-dependent first order reaction. These cumyloxy radicals abstract the more highly labile hydrogens from polymers to form cumyl alcohol. They also split out acetophenone, leaving more reactive methyl radicals which can abstract less active hydrogen atoms. The relative extent to which each reaction occurs depends on the polymer and environment. In the presence of acidic materials, these reactions are also accompanied by ionic cleavage of the peroxide.

Active sites created in polymer chains by removal of hydrogen atoms induce cross-linking by coupling with similar sites in other chains. However, other materials used in rubber compounds may also react with these free radicals or induce ionic cleavage and thus increase the amount of dicumyl peroxide required for vulcanization. Data are presented which illustrate how the chemistry of dicumyl peroxide vulcanization affects the utility in crosslinking various polymers, and the selection of suitable fillers, plasticizers, antioxidants, antiozonants, and accessory materials. The data presented provide fundamental information which will allow the compounder to utilize the demonstrated and potential advantages of dicumyl peroxide vulcanization.

**Chemistry of Vulcanization of Viton A Fluorocarbon Elastomer.** ***J. F. Smith (DuPont).*** Diamines, and the newer types of curing agents, are reviewed briefly. The curing action of tert.-amines and of dithiols are particularly discussed from the mechanistic point of view. Physical data (Relaxometer, Resilience/crosslink density relationships) are presented indicating that the process of crosslinking is complex, involving chain scission in addition to crosslink formation. Analogies are drawn to reversion and chain scission during cure of other elastomers.

The action of amines on Viton A in solution is described showing differences between 1°, 2° and 3° amines in degree of HF spit off. Infrared evidence is presented that unsaturated centers develop during the treatment and that incorporation of amine into the polymer chain occurs. The action of peroxides and high energy radiation on Viton is described, showing from infrared spectra that HF elimination is involved and that some centers of heat instability are introduced which cause crosslink formation on further heating. The role of acid acceptors in the cure is discussed, and a mechanism for the curing reaction proposed.

**Crystallization and Cure Studies of Neoprene W Using Dielectric Measurements.** ***M. Hanok and I. N. Cooperman (N. Y. Naval Shipyard).*** A study of a Neoprene W compound in the elastomeric state was conducted to determine the usefulness of measurements of dielectric constant and dielectric loss in showing the extent of cure of this linear polar polymer and in following crystallization changes as a time-dependent phenomenon occurring in the elastomer in the unstressed state. The work was based on concepts that increased hindrance to rotation of the polar polymeric chains in an alternating electric field, either in the form of additional network crosslinks or increased orientation of the polymer chain segments, would decrease the dielectric constant at a given frequency, and that vulcanizates in different states of cure should demonstrate differences in critical frequency and differences in dielectric loss and the dielectric constant at the critical frequency.

A Neoprene W stock was cured at 290°F at periods ranging from 30 minutes to 200 minutes. Measurements of dielectric constant and dielectric loss were made on these vulcanizates at intervals ranging from 1 hour to 36 weeks after cure, at frequencies ranging from 50 cycles to 75 megacycles, and at temperatures ranging from 74°F to temperatures above the melting temperatures of Neoprene W crystallites. Volume swell measurements in benzene were made to establish the degree of crosslinking. Stress-strain measurements were made to indicate the state of cure. X-ray diffraction diagrams were made to verify crystallization.

The results indicated differences in the cure of the experimental vulcanizates and showed sensitivity of the dielectric constants to crystallization and to changes in crystallization occurring with time after cure. Rate constants for crystallization were calculated from the dielectric data and

used to calculate the activation energy for crystallization from the Arrhenius equation. The Cole and Cole diagrams were examined for Debye theory adherence. The activation energies for relaxation in Neoprene W were compared with those of other polymers discussed.

**Investigation of Radical and Polar Mechanisms in Vulcanization Reactions.** ***J. R. Shelton and E. T. McDonel (Case Institute of Technology).*** The fundamental nature of the mechanism of vulcanization of styrene-butadiene rubber has been investigated for a number of curing systems. Hydroquinone and other materials known to act as free-radical stoppers have been used to determine whether an ionic or free-radical mechanism is involved in each case. This is accomplished by observing the rate of formation of crosslinks, as determined by swelling measurements, in each curing system with and without the free-radical scavenger.

The method has been tested with known systems and then applied to systems in which the mechanism was unknown. Thus, the generally accepted free-radical nature of the mechanism involved in vulcanization with peroxides is confirmed by a decrease in rate of crosslink formation in the presence of free-radical stoppers. Similarly, the polar mechanism which has been proposed for an unaccelerated rubber-sulfur cure is confirmed by a small increase in rate of crosslink formation in the presence of hydroquinone, rather than a decrease. Many of the commonly used accelerated sulfur curing systems and accelerator curing systems without free sulfur have been investigated. The classification of each of these systems for vulcanizing styrene-butadiene rubber, according to whether the mechanism is predominantly polar or free radical as determined by this method, is presented in this discussion of the subject.

## Thursday, November 12

### Concurrent Afternoon Program

Natural Rubber and Latex — Synthetic and Natural

**Contrasts in the Response of Elastomers to High Temperature Vulcanization.** ***F. B. Smith (Naugatuck Chemical).*** Typical tread and carcass compounds of natural rubber, styrene rubber (and blends thereof), butyl, and polychloroprene were vulcanized at temperatures from 292°F to 500°F. Contrasts in the response of these elastomers to the higher vulcanizing temperatures were studied in terms of basic physical properties.

Within this curing range an increase in the vulcanization temperature exerted a deleterious effect on all polymers except resin cured butyl. The effect is most marked above 370°F. However the magnitude of this effect varies for each elastomer. Natural rubber reverts badly. In general the synthetics SBR and NBR show a superiority to Hevea at the higher curing temperatures. In these tests polychloroprene showed marked instability. Resin cured butyl showed flat curing and aging characteristics up to 500°F curing temperature. Certain implications of these results are summarized with respect to the selection of elastomers for high temperature vulcanization applications.

**Recent Developments in Superior Processing Rubber.** ***H. C. Baker (British Rubber Producers Research Association).*** Superior processing rubber is an intimate 1:4 blend of vulcanized and unvulcanized rubber prepared in Malaya by patented processes. In the three years since the introduction SP crepe the consumption of superior processing first quality grades of sheet and crepe has steadily grown to a four-figure annual tonnage in 1958. The characteristics of superior processing rubber resulting from its two-phase nature, and their consequences in simplifying, cheapening, and enlarging the scope of manufacturing operations are briefly described, and a short account of the field of usage of superior processing rubbers is given.

Recent developments in Malaya have centered on the production by a patented process of superior processing rubber containing a much higher proportion of crosslinked rubber, which has been used to prepare superior processing brown crepe from estate scrap and SP-90 for use by manufacturers as a compounding ingredient and processing aid by blending with any desired grade of natural rubber or with styrene rubber or certain other synthetic rubbers.

The use of SP-90 to achieve greater flexibility of compounding is discussed, and some particular examples of its application are given. The results are presented of a comparative study of blends of ordinary NR, SP rubber, SP-90, SBR 1009 cross-linked polymer, with SBR types in gum stocks, white and black loaded compound for extrusion properties and physicals of unaged and aged vulcanizates. Other data include results from a pilot plant evaluation of SP. RSS in pure gum and white loaded stocks for calendering and extrusion in comparison with ordinary RSS, and laboratory studies of the processing, vulcanizing and aging characteristics of superior processing rubbers in comparison with ordinary natural rubber in the absence and presence of conventional processing aids.

**Factors Influencing the Stability of Styrene Rubber Latex.** ***F. A. Sliemers, B. Bennett, P. B. Stickney and G. Heiligmann (Battelle Memorial Institute).*** The theory is proposed that latex destabilization proceeds by means of a time-dependent localized polymer-particle dehydration. The dehydration apparently occurs in two stages. In the initial stage, more or less reversible aggregates are formed. This "creaming" is accompanied by a perceptible increase in latex viscosity. In the second stage, the aggregates are further dehydrated and coalescence occurs. This process is irreversible.

Evidence is presented to support the argument that the prime requirement for the dehydration and, consequently, for the destabilization of high-stability latex is the presence of a static latex surface in contact with an unsaturated gas phase. The three factors involved here are (1) surface area; (2) surface agitation; and (3) gaseous head space. In addition, it is shown that stability is influenced by a number of other factors, including (1) temperature; (2) polymer concentration; and (3) polymer-particle size.

**The Colloidal Properties of Synthetic Copolymer Latices.** ***C. F. Fryling (Koppers Co.).*** Harkins, Maron and others have conducted extensive investigations on the role of surface active agents during emulsion copolymerization to form synthetic rubber latices. They demonstrated that emulsion polymerization owes its unique characteristics to solubilization of monomers by "soaps" at higher than critical micelle concentrations. However, this theory is inadequate to explain the gelation of latex which is obtained under certain well-defined conditions. It appears probable that gelation of latex has not received its due consideration because initiation of emulsion polymerization is usually induced with potassium persulfate; thereby introducing an electrolyte which effectively prevents gelation.

Theoretical analysis of variations of pH observed in emulsion polymerization processes indicates that hydrolysis of fatty acid soaps is an important factor in establishing the colloidal properties of synthetic rubber latices. It is based upon the Bronsted and Bjerrum relationship that the primary salt effect increases the acid activity of weak acids. This analysis is also in agreement with the findings of Per Ekwall on "Concentration Limits in Association Colloid Solutions" (*J. Colloid Sci.*, 1954 supplement, pp. 66-80).

The gelation of latex can be visualized in accordance with the above theory as the establishment by hydrogen bonding of ligands of fatty acid molecules between the latex particles. There results a three dimensional network, which can be readily broken by the addition of electrolytes. Thus the anomaly of gel formation by latex particles of only 0.2 $\mu$ diameter, in con-

trast with theories that "stress the importance of large colloidal particles," is readily explained. In addition to gelation, the following related phenomena are considered: inversion by hydrophilic protective colloids; film formation involving a transitory sponge structure intermediate between oil-in-water and water-in-oil systems; and concentration by an improved method to give high solids, low viscosity latex.

**Latex Masterbatching: Compounding, Development, Future Possibilities, and Influence on Rubber Manufacture.** ***I. Drogin (United Carbon).*** The net masterbatching of styrene-butadiene rubber latex with oil and/or carbon black has resulted in quality and economic advantages for consumers. Some of the quality advantages are improved dispersion, assurance of better product uniformity and equal or better abrasion resistance than that obtained with a corresponding dry mix; and some of the economic advantages are lower processing costs, cleaner production, and simplification of warehousing, handling and maintenance.

Increased interest in wet latex masterbatching of carbon black has been spurred on by the development of more effective means of improving the carbon black dispersion, and also by making available to consumers a wider selection of masterbatched polymers. This has resulted in greater acceptance of latex masterbatching. For the first 10 months of 1958, 40.3 per cent of the total production of styrene-butadiene rubber was wet masterbatched in the latex stage, of which 30.4 per cent was with oil, 4.6 per cent with carbon black, and 5.3 per cent with carbon black and oil. Now available are polymers that are extended with naphthenic or aromatic oils at 25-50 parts per 100 parts rubber hydrocarbon, or with oil and carbon black, or masterbatched with carbon blacks of the SAF, ISAF, HAF, EPC, FEF, SRF and MT types at various loadings with or without added processing oil.

It is felt that the ultimate goal in wet latex masterbatching would be to produce a completely compounded polymer to satisfy consumers' requirements, and which would also be in a form readily available for shipment in bulk and for direct processing. It is also envisioned that the final (productive) latex masterbatched compound would be pelletized at the point of origin and shipping bulk.. The pellets would then be air conveyed, stored in bulk and fed from a hopper into the final processing machinery, e.g., a tuber for extrusion directly to a desired contour, such as a tire tread. The new equipment is expected to substantially reduce the use of present heavy, power-consuming mills and materially reduce the capital requirement for rubber manufacture. Wet latex masterbatching is, without doubt, a stepping stone to an improved product with better uniformity, and to reduction in labor and equipment costs. Further improvements in this type of masterbatching will bring about additional product quality and economic advantages for consumers.

**Stability Testing of Natural and Synthetic Latices.** ***J. L. M. Newnham and D. J. Simcox (Dunlop Rubber).*** Though a mechanical stability or M.S.T. test for natural latex has now been internationally recognized, no method for testing the chemical stability of natural latex has yet reached the same state of development and recognition. A study has been made of the effect of factors controlling the mechanical stability time of latex in the presence of zinc oxide, and a zinc oxide stability or Z.S.T. test is proposed. This new test is very reproducible, is quite independent of inter laboratory variables such as the zinc oxide dispersion, and takes account of latex variables affecting the solubility of zinc oxide in latex serum. It gives a useful measure of the zinc sensitivity which allows choice of a latex for a particular type of process, or for control checking of consecutive latex batches.

The development of a zinc oxide stability test of similar applicability for cold rubber high solids synthetic latices is also described. Finally zinc stability testing data is presented for blends of natural and synthetic latex. This data gives an indication for a given synthetic latex how much may be blended with natural without adversely affecting processability. The test procedure is suggested as a laboratory method for the determination of this quantity when dealing with different types and batches of natural and synthetic latex.

**A Strain Test for Latex Films and Its Application.** ***P. R. Gyss and Charles E. Wu (Socfin).*** A technique for casting molded test specimens from compounded natural rubber latex concentrate is described. The relationship between specimen thickness and "strain-value" is found to be of the same nature as that arrived at by other workers using specimens molded from compounds prepared by milling solid rubber. The correlation between "strain-value" and modulus at 100 per cent elongation obtained on specimens prepared by the technique described is also given.

On the basis of these tests it is demonstrated that naturally occurring variability between identically preserved latices is small, but different types of preservation result in vulcanized films of different physical properties. It is further shown that variations in the physical properties of cured latex films are reflected in the compressibility of foam-rubbers prepared from the latices provided the foams are of identical structure. The main cause for variability in foam rubber is however shown to be its structure. The equipment used for the strain, modulus and compression tests is described in some detail.

## Friday, November 13
### Morning Program
**Polymers and Polymer Structure**

**Elastomeric Succinic and Anhydrosuccinic Derivatives of Natural Rubber.** ***C. P. Pinazzi and G. Milbert (Institut Francais du Caoutchouc).*** Maleic anhydride reacts with the natural rubber hydrocarbon according to two main structural considerations: a radical reaction causing the participation of two carbons of the maleic double bond, thereby creating intermolecular bridges; a substituent addition of the anhydride on the methylene groups of the polyisoprene chain. The latter reaction has been studied in the hope of succeeding in fixing the anhydrosuccinic functions on the rubber molecule while avoiding the secondary effects of bridging or scission.

An extensive analytical study has established the reality of this reaction. The most favorable physical conditions for bringing it about are: heavy aromatic solvent, elevated temperature, 170°-240°C., with optimum around 225°C., absence of oxygen and promotors of radicals, presence of anti-oxygen substances. The yield of the conversion in relation to the anhydride, has also received our attention and we have been able to improve it appreciably. Several chemical derivatives of anhydrosuccinic rubber were prepared; polycarboxylic rubber, polybenzylic ester and polyanilide. Infra-red spectrography confirmed the structure expected.

Vulcanization of these elastomers was also investigated. Besides sulfur vulcanization which is possible between 0 per cent and 5 per cent of combined anhydride, a varied range of crosslinking agents was studied: metallic oxides, polyols, polyamines and diisocyanates. It seems that the best mechanical properties are obtainable with ZnO. Finally water plays an important part in these vulcanization phenomena.

Various types of succinic rubber have been studied as to their technological properties. One of the outstanding characteristics seems to be their special capacity for reinforcement. The mechanical properties obtained on the whole are excellent and it should be noted that high elasticity is retained, at least if the combined anhydride is kept this side of 20 percent. Finally, the solvent resistance of these vulcanizates is closer to that of the nitrile rubbers than to that of natural rubber, as indeed are their solubilities in the unvulcanized state.

**Cis-Trans Isomerisation in Natural Polyisoprenes.** ***J. I. Cunneen (British Rubber Producers Research Assoc.).*** The naturally occurring polyisoprenes, rubber *(cis)*, gutta-percha *(trans)*, and squalene *(trans)*, have been isomerized for the first time by reaction

with substances which add reversibly to double bonds, i.e., the reagent adds to a double bond and then rapidly splits off again to re-form the double bond, sometimes of different configuration to the original. Thiol acids, certain disulfides, and sulfur dioxide are efficient reagents for carrying out these configurational changes.

Isomerisation was detected spectroscopically in the infra-red, and experiments with a model olefin having the isoprenoid structure, 3-methylpent-2-ene, showed that its *cis* and *trans* forms were rapidly converted into an equilibrium mixture on reaction with the above reagents. Later studies with the polyisoprenes themselves have shown that similar isomerization occurs, the extent of isomerization being followed quantitatively. Configurational changes in the double bonds of natural rubber and gutta-percha cause marked changes in physical properties. For example, conversion of only a few percent of the double bonds in natural rubber from the *cis* to the *trans* form reduces the rate of crystallization at low temperature several hundred-fold, while the reverse change in gutta-percha gives a rubber-like polymer at room temperature.

**Polymerization of Vinyl Monomers in Rubber Latices. *P. W. Allen, C. L. M. Bell, E. G. Cockbain and R. B. Mumford (British Rubber Producers Research Assoc).*** Methods of initiating polymerization of various vinyl monomers in natural and synthetic rubber latices are reviewed, with particular reference to techniques producing little or no homopolymer. Kinetic data are presented for polymerizations in natural rubber latex, using either water-soluble or rubber-soluble initiators. With some monomers such as methyl methacrylate, the kinetic results indicate that inter-molecular association occurs between the growing polymethyl methacrylate chains to give submicroscopic aggregates of very high viscosity. In these cases, the rate determining step in the polymerization process is the diffusion of monomer into the aggregates. Evidence is given to show that the *distribution* of such aggregates within the parent latex particles is affected by the nature or the polymerization initiator.

With water-soluble or combinations of water-soluble and rubber-soluble initiators, the aggregates are believed to be formed preferentially in the surface regions of the latex particles. One consequence of this non-uniform distribution is that the smaller latex particles contain a greater percentage of polymerized monomer than the larger particles. The colloidal and film-forming properties of the resulting graft polymer latices are also markedly influenced by the distribution of the aggregates within the latex particles. Methods of effecting the re-distribution of the polymerized monomer in graft polymer latex films are discussed.

**Properties of Tin Elastomers. *J. C. Montermoso, T. M. Andrews, L. P. Marinelli and B. LaLiberte (Quartermaster Research and Development Centre).*** Studies on organo-tin compounds were directed toward development of new elastomers having a combination or combinations of two or more of the following properties: flame-retardance, chemical resistance, thermal stability at high temperatures, and flexibility at low temperatures. Tin elastomers have been successfully synthesized by the reactions of tin oxides and organic compounds. Monomers containing tin have also been made, which in turn, can be copolymerized with other types of monomers to produce elastomers possessing the desired characteristics. Monomers containing phosphorus, fluorine, and chlorine have been copolymerized with the tin monomer to produce elastomeric materials. The following phases of investigations on tin elastomers will be discussed: polymerization, vulcanization techniques, and the physical and chemical properties of the base gum and of the vulcanizates.

**Silicone Rubber—Today and Tomorrow. *P. C. Servais and K. E. Polmanteer (Dow Corning).*** This paper describes the rapid growth of silicone rubber in the last fifteen years, its present status, and some predictions of its potential. There were few uses for silicone rubber until design engineers became aware of its resistance to heat, cold, and weathering. Now silicone rubber finds use in many different industries. It seals domestic steam irons, pharmaceutical vials and aircraft and missile access doors. It insulates spark plugs, atomic reactor control wiring and industrial current transformers. These widespread uses have increased production and make possible repeated price reductions. Wider use should generate future price reductions.

All of the early silicone rubber formulations were based on dimethyl silicone polymer. The substitution of other organic groups for some of the methyl groups alters the properties of present day silicone rubbers in many useful ways. For example, phenyl groups enhance high and low temperature utility, vinyl groups control vulcanization and reduce compression set, cyano and fluoro-organo groups improve oil and fuel resistance. Many more groups are being studied to improve the strength and resistance of the silicone rubbers of the future. Compounding was once done only by the polymer manufacturers. Now, polymers and partly reinforced polymers are available to the rubber compounders. Many improvements should come from the work of these compounders.

Vulcanization, once done only with organic peroxides, can now be done with sulfur, organo-metallic salts, and radiation. Vulcanization temperatures can be varied from room temperature to 650°F. Vulcanization times can vary from a few seconds to days. Hot air, steam, hot liquids, and radiation can all be used. New developments in this area seem unlimited. Judging from the rapid sequence of silicone rubber developments in the past, it appears that the future should hold similar advances in polymers, reinforcing fillers, vulcanization systems and applications.

**The Structure of Chlorosulfonated Polyethylene. *A. Nersasian and D. E. Anderson (DuPont).*** The chlorines in chlorosulfonated polyethylene, Hypalon synthetic rubber, have been characterized by kinetic analysis according to the method of Saloman. It is found that 2.7 per cent of the total chlorine is primary, 89.8 per cent secondary, 3.5 per cent tertiary, and 4 per cent is sulfonyl chloride. These results are in accord with statistical calculations based on a polyethylene model containing the same methylene to methyl group ratio as the polyethylene precursor of Hypalon. The types and approximate quantities of dichlorides in Hypalon have been determined by reactions with potassium iodide and zinc dust.

## Friday, November 13

### Afternoon Program

Section A—Rubber Chemicals

Session B—Adhesion

Session C—Polyurethanes

### Session A

**A Study of the Behavior of Selected Derivatives of p-Phenylene Diamine in Rubber Compounds. *J. T. Watts and E. R. Thornley (Imperial Chemical Industries).*** A number of derivatives of p-phenylene diamine have been examined to determine their antiozonant properties in styrene rubber and natural rubber over a wide range of conditions. A new dynamic exposure test suitable for both ozone cabinet and outdoor testing has been developed in which use is made of the De Mattia flexing machine. It will be demonstrated that by reducing considerably the maximum strain in the testpiece and by testing in an atmosphere containing ozone, typical systems of ozone cracking are produced in place of the flexcracking obtained in the standard De Mattia test. The relationship between the two types of test (flexcracking and ozone cracking) is discussed.

The quite reasonably good correlation obtained between the results of the modified De Mattia test and those of ozone resistance tests carried out on actual tires, using an outdoor wheel test, is demonstrated. It is shown that the relative efficiency of one antiozonant

as compared with another varies significantly according to the type of polymer use, the test (or service) conditions and the order of protection required. 4 isopropyl amino-diphenylamine (N phenyl-N'-isopropyl p-phenylene diamine) has outstanding antiozonant properties, especially under dynamic conditions of exposure. This particular chemical is selected for additional compounding studies which include an investigation of its behavior when used in conjunction with various waxes and a consideration of certain specific applications.

### Session B

**Studies on the Mechanism of Adhesion in Polymeric Systems.** ***S. B. Robison and D. J. Buckley (Esso Research & Engineering).*** The attainment of strong bonds between polymers and between polymers and non-polymer substrates is an area of major importance from a technological standpoint. Despite this fact, it is only recently that efforts have been made to understand the basic principles involved in adhesion of polymeric systems. This paper reports on research directed towards a better understanding of the mechanism of the process of establishing strong bonds between similar and dissimilar polymeric materials.

Adhesion in polymeric systems is considered as being dependent on three factors: (1) diffusion of polymer chains in sufficient numbers across the interface and to a sufficient depth below the surface of the interface; (2) mutual compatibility of the chains in terms of similarity of chemical composition and chain flexibility; and (3) for permanently bonded systems (crosslinkable materials), a similarity or mutual acceptability in the crosslinking reaction.

Diffusion as a function of time, pressure and temperature is considered in reference to the viscosity of the polymers employed. Immobilization of the diffusion process for materials capable of crosslinking during the diffusion period is analyzed as to its effect on adhesion. Mutual compatibility of the polymeric materials forming the bond interface is described as determined by several methods.

Layering of polymer blends from solutions in solvents of varying interaction coefficients is particularly useful in this regard. The adhesion of butyl polymers to themselves and to styrene rubber and natural rubber represents the type of polymer pairs studied in this work. Halogen containing copolymers of isobutylene-isoprene such as MD-551 and MD-572 are found to be effective in achieving strong bonds between butyl and the higher diene polymers. The contribution of these polymers to the bonding system is discussed in terms of the rate and nature of the vulcanization reactions.

**Some Aspects of Rubber-Textile Adhesion.** ***G. M. Doyle (Dunlop Rubber).*** Latex/resorcinol - formaldehyde adhesives for bonding textile to rubber are generally prepared by condensing resorcinol and formaldehyde under alkaline conditions, at least partially in the presence of a rubber latex. It is shown that, under constant conditions of treatment of the textile, the bond strengths given by typical adhesives exhibit a close relationship to the average number of available reactive sites per resorcinol unit in the resins formed at the time of application to the textile. Resins of different degrees of condensation are required for maximum adhesion, depending on the latex used in the adhesive and the textile to be bonded.

A further condensation of the resin can take place during the processing of the textile after treatment with adhesive and the number of reactive sites which ultimately determines the bond strength is believed to be that at the time of vulcanization. As distinct from latex/resorcinol-formaldehyde systems in which the resin is already partially formed in the adhesive applied to the textile, the reaction to form the resin can also be made to take place entirely during the vulcanization of the cord-rubber assemblage. In this case also, there is evidence of a relationship between bond strength and the compositions of the resin.

### Session C

**Relation of Structure to Properties in Polyurethanes.** ***E. F. Cluff and E. K. Gladding (DuPont).*** The influence of crosslink structure on the gum vulcanizate properties of a polyurethane elastomer is described. The elastomer contained the polytetramethylene ether moiety as its main constituent and pendant hydroxyl and carbon-carbon double bonds were attached at intervals along the chain. Curing was effected by either diisocyanates or an accelerated sulfur recipe to give crosslinks of different chemical structure. Isocyanate-terminated prepolymers of different lengths were also used as crosslinking agents to investigate the influence of crosslink length. Vulcanizate properties measured were modulus, resilience, hardness, and compression set. A method for distinguishing between mono- and disulfide crosslinkages is described also.


**REPRINTS**

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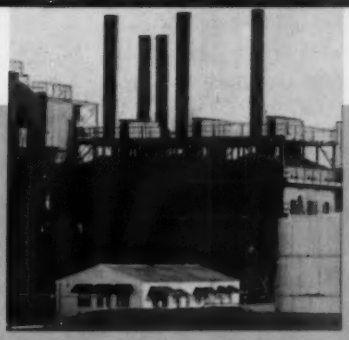

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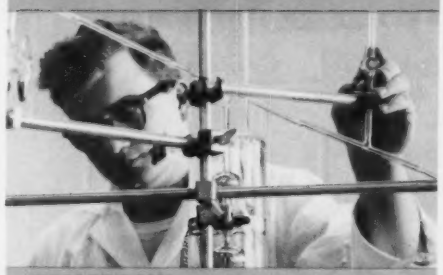

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# Rubber Manufacturing Industry Plant Vacation Schedules

**As a service to the rubber industry and its suppliers, there appears below a listing of those companies which have announced vacation schedules during which time the plants will close. It may be said, however, that many of the companies involved will maintain standby staffs during the period. The dates appearing after each company name may or may not be inclusive and appear as reported by the individual concerns. Where more than one plant is involved, the listing will so state. The listings are, of course, published for guidance only.**

## United States

### A

Accurate Mfg. Co., Garfield, N. J. (July 3-July 21).
Accurate Products Co., San Diego, Calif. (June 27-July 13).
Ace Rubber Products, Inc., Akron, Ohio (July 5-July 18).
Acme-Hamilton Mfg. Corp., Trenton, N. J. (Acme Division July 12-July 26); (Hamilton Division July 26-Aug. 9).
Acme Rubber Mfg. Co., Trenton, N. J. (Plant #1 July 26-Aug. 9; Plant #2 July 12-July 26—Office will be open).
Acushnet Process Co., New Bedford, Mass. (June 29-July 13).
Alco Oil & Chemical Corp., Philadelphia, Penna. (July 2-July 13).
Aldan Rubber Co., Philadelphia, Penna. (July 27-Aug. 10).
Allied Chemical Coatings, Inc., Lynn, Mass. (July 3-July 13).
American Biltrite Rubber Co., Trenton, N. J. (June 29-July 6; Partial Production July 6-July 13).
American Container Corp., Huntington, West Va. (July 5-July 19); Rock Island, Ill. (June 21-July 6).
American Finish & Chemical Co., Chelsea, Mass. July 3-July 13).
American Rubber Corp., Albertville, Ala. (June 26-July 13).
American Rubber Products Corp., La Porte, Ind. (July 31-Aug. 10).
Ames Rubber Corp., Hamburg, N. J. (July 19-Aug. 3).
Angier Adhesives, Cambridge, Mass. (July 2-July 20).
Apex Molded Products Co., Philadelphia, Penna. (July 20-Aug. 3).
Archer Rubber Co., Milford, Mass. (June 26-July 6).
Arjay Plastic Products Co., Ridgefield Park, N. J. (July 27-Aug. 10).
Armstrong Rubber Mfg. Co., Des Moines, Iowa (Aug. 24-Sept. 8).
Artcraft Rubber Products, Inc., Pottstown, Penna. (July 1-July 15).
Asbestos Mfg. Co., Huntington, Ind. (July 3-July 20).
A-S-H Molded Products Co., Malvern, Penna. (June 26-July 6).
Associated Gaskets, Inc., Bridgeport, Conn. (July 3-July 13).
Associated Rubber Inc., Quakertown, Penna. (July 27-Aug. 1).
Associated Rubber & Plastic Corp., Bronx 51, N. Y. (June 27-July 13).
Atlantic India Rubber Works, Inc., Chicago, Ill. (July 4-July 12—Office and warehouse open).
Auburn Rubber Co., Auburn, Ind. (June 27-July 13).
Avon Sole Co., Avon, Mass. (June 27-July 13).

### B

B. B. Chemical Co., Cambridge, Mass. (July 4-July 20).
Badger Outerwear Mfg. Co., Port Washington, Wisc. (July 3-July 13).
Baldwin Rubber Co., Pontiac, Mich. (June 29-July 6).
Baltic Rubber & Plastics, Inc., Baltic, Ohio (July 3-July 20).
Barco Mfg. Co., Barrington, Ill. (July 20-Aug. 3).
Bardon Rubber Co., Union Grove, Wisc. (June 29-July 7).
Barge Cement Mfg. Co., Towaco, N. J. (July 3-July 10).
Barry Controls, Inc., Watertown, Mass. (July 6-July 20).
Baxter Laboratories, Inc., Morton Grove, Ill. (Aug. 1-Aug. 16).
Bay Div., Parke, Davis & Co., Bridgeport, Conn. (July 13-July 27).
Bearfoot Sole Co., Wadsworth, Ohio (June 26-July 6).
Beebe Rubber Co., Nashua, N. H. (July 6-July 17).
Bell Rubber Co., Dallas, Texas (July 4-July 13).
Belmont Packing & Rubber Co., Philadelphia, Penna. (July 3-July 12).
Bemco., Inc., Portsmouth, Ohio (July 3-July 13).
Richard Best Pencil Co., Springfield, N. J. (July 24-Aug. 10).
Bond Rubber Corp., Derby, Conn. (July 4-July 12).
Bonded Fibers, Inc., Buena Vista, Va. (July 4-July 20).
Borden Chemical Co., Middlesex, N. J. (June 29-July 12); Peabody, Mass. (July 6-July 19).
Boston Insulated Wire & Cable Co., Boston, Mass. (July 2-July 19).
Boston Woven Hose & Rubber Co., Cambridge, Mass. (June 29-July 13).
William Brand & Co., Willimantic, Conn. (July 4-July 19).
Bristol Mfg. Corp., Bristol, R. I. (Aug. 1-Aug. 16).
Brown Rubber Co., Lafayette, Ind. (June 27-July 6).
Arthur S. Brown Mfg. Co., Tilton, N. H. (June 26-July 13).
Buffalo Weaving & Belting Co., Buffalo, N. Y. (July 20-31).

### C

Cambridge Rubber Co., Taneytown, Md. (June 27-July 12).
H. O. Canfield Co., Clifton Forge, Va. (July 4-July 12).
Carlisle Tire & Rubber Div., Carlisle, Penna. (June 29-July 6).
Carr Manufacturing Corp., Bristol, R. I. (July 4-July 19).
Carr-Fulflex, Inc., Bristol, R. I. (July 4-July 19).
Cartex Corp., Morrisville, Penna. (July 3-July 17).
Thomas A. Caserta, Inc., Trenton, N. J. (July 12-July 26).
Castle Rubber Co., East Butler, Penna. (July 4-July 19).
Central Rubber Co., Belvidere, Ill. (June 27-July 12).
Chamberlain Corp., Waterloo, Iowa (June 29-July 20).
Chase & Sons, Inc., North Quincy, Mass. (July 10-July 20); Randolph, Mass. (July 10-July 20).
Chemical Products Inc., Detroit, Mich. (July 17-Aug. 10).
Chemical Rubber Products Inc., Beacon, N. Y. (Aug. 24-Sept. 8).
Chicago Allis Mfg. Co., Chicago, Ill. (July 1-July 17).
C. F. Church, Division of American Standard, Monson, Mass. (Aug. 24-Sept. 7); Holyoke, Mass. (Aug. 24-Sept. 7); Brattleboro, Vt. (Sept. 11-Sept. 28).
Circle Wire & Cable Corp., Maspeth 78, N. Y. (July 4-July 19).
Clark-Cutler-McDermott Co., Franklin, Mass. (June 27-July 6).
Clevite-Harris Products, Inc., Milan, Ohio, and Napoleon, Ohio (July 18-Aug. 3).
Coaters, Inc., New Bedford, Mass. (July 3-July 14).
Collette Mfg. Co., Amsterdam, N. Y. (July 3-July 13).
Collyer Insulated Wire Co., Pawtucket, R. I. (July 3-July 20).
Colonial Rubber Co., Ravenna, Ohio (June 29-July 13).
Colt's Plastics Co., Inc., N. Grosvenordale, Conn. (July 26-Aug. 2).
Conneaut Rubber & Plastics Co., Conneaut, Ohio (July 6-July 20).
Connecticut Hard Rubber Co., New Haven, Conn. (July 25-Aug. 10).
Continental Rubber Works, Erie, Penna. (June 29-July 13).
Converse Rubber Co., Malden, Mass. (July 25-Aug. 10).
Cooke Color & Chemical Co., Hackettstown, N. J. (July 3-July 14).
Cords, Ltd., Division of Essex Wire Corp., DeKalb, Ill. (July 4-July 13).
Cornish Wire Co., New York, N. Y., and Williamstown, Mass. (June 29-July 7).
Cory Rubber Co., Marion, Ohio (July 5-July 11).
Crescent Insulated Wire & Cable Co., Trenton, N. J. (July 18-Aug. 2).
Crown Products Co., Ralston, Nebr. (June 22-July 6).
Crown Rubber Co., Fremont, Ohio (June 29-July 13).
Crushproof Tubing Co., McComb, Ohio (July 3-July 13).

### D

DPR, Inc., Belleville, N. J. (July 17-Aug. 3).
Darling Valve & Mfg. Co., Williamsport, Penna. (June 29-July 13).
Davol Rubber Co., Providence 2, R. I. (July 17-Aug. 3).
De Laval Separator Co., Poughkeepsie, N. Y. (July 17-Aug. 3).
Delford Rubber Co., Middletown, N. Y. (June 29-July 5).
Delta Rubber Co., Moosup, Conn. (July 3-July 11—stand-by personnel).
Denman Rubber Mfg. Co., Warren, Ohio (June 28-July 6).
A. P. deSanno & Son, Inc., Phoenixville, Penna. (July 20-Aug. 10).
Dill Mfg. Co., Cleveland, Ohio (July 6-July 20).
Dryden Rubber Division, Montpelier, Ind. (June 29-July 6—partial shutdown).
Dunlop Tire & Rubber Corp., Buffalo, N. Y. (July 27-Aug. 10).
Dunlop Tire & Rubber Corp., Utica, N. Y. (July 27-Aug. 10).
Durable Display Mfg., Inc., Chicago, Ill. (July 4-July 19).
Durkee-Atwood Co., Red Wing, Minn. (June 26-July 13).
Duro Gloss Rubber Co., New Haven, Conn. (July 3-July 13).

### E

Eagle Rubber Co., Ashland, Ohio (June 21-June 27).
Eastern Molding Co., Belleville, N. J. (July 2-July 13).
Easthampton Rubber Thread Co., Stuart, Va. (June 26-July 6).
Eclat Rubber Co., Akron, Ohio, and Cuyahoga Falls, Ohio (June 27-July 13).
Edmont Mfg. Co., Coshocton, Ohio (June 28-July 13).
Eis Automotive Corp., Middletown, Conn. (Aug. 1-Aug. 17).
Ekco Products Co., Whittier, Calif. (June 29-July 13).
Electric Hose & Rubber Co., Wilmington, Del. (July 24-Aug. 10).
Elmhurst Rubber Co., Elmhurst, N. Y. (Aug. 3-Aug. 14).
Endicott Johnson Corp., Endicott, N. Y., and Johnson City, N. Y. (July 20-July 26).
Endura Corp., Quakertown, Penna. (July 18-Aug. 2).
Enduro Rubber Co., Ravenna, Ohio (July 4-July 20).
Excel Rubber Co., Goshen, Ind. (July 3-July 20).

### F

Eberhard Faber Pencil Co., Rubber Div., Newark, N. J. (July 17-Aug. 3).
Fabric Fire Hose Co., Sandy Hook, Conn. (July 20-Aug. 3).
Faultless Rubber Co., Ashland, Ohio (June 20-July 6).
Fibre Leather Mfg. Corp., New Bedford, Mass. (July 3-July 13).

Firestone Rubber & Latex Products Co., Fall River, Mass. (June 27-July 6).
Flexan Corp., Chicago, Ill. (Aug. 3-Aug. 14).
Flexaust Co., New York, N. Y., and Amesbury, Mass. (July 4-July 12).
Flexible Tubing Corp., Guilford, Conn. (June 29-July 7).
Fli-Back Co., High Point, N. C. (July 3-July 13).
Fo-MacEnterprises, Inc., Tulsa, Okla. (July 2-July 20).
Foss Mfg. Co., Haverhill, Mass. (June 27-July 6).

## G

Garfield Rubber Products Inc., Garfield Heights, Ohio (July 6-July 20).
Garrett Flexible Products, Inc., Garrett, Ind. (June 26-July 13).
Gates Engineering Co., Wilmington, Del. (July 6-July 13).
Gatke Corp., Chicago 1, Ill. (July 3-July 13).
Geauga Industries Co., Middlefield, Ohio (July 25-Aug. 10).
General Asbestos & Rubber Div., N. Charleston, S. C. (June 29-July 12).
General Insulated Wire Works, Inc., Providence, R. I. (July 6-July 20).
General Latex & Chemical Corp., Cambridge 39, Mass. (June 27-July 13).
General Rubber Corp., Tenafly, N. J. (July 20-Aug. 3).
General Tire & Rubber Co., Akron, Ohio (Aug. 24-Aug. 31); Waco, Texas (Aug. 17-Aug. 24).
Geneva Rubber Co., Geneva, Ohio (July 3-July 13).
Georgia Leather Co., Newark, N. J. (July 4-July 20).
Glade Mfg. Co., Chicago, Ill. (June 26-July 7).
Globe Mfg. Co., Fall River, Mass. (June 29-July 13).
Goodall Rubber Co., Trenton, N. J. (July 27-Aug. 10).
Goodall-Sanford Inc., Reading, Mass. (July 6-July 7).
B. F. Goodrich Sponge Products Div., Shelton, Conn. (June 29-July 13).
Goodyear Footwear Corp., Providence, R. I. (June 26-July 13).
Goodyear Rubber Co., Middletown, Conn. (July 27-Aug. 8).
Goodyear Tire & Rubber Co., Windsor, Vt. (July 6-July 13).
Goshen Rubber Co., Goshen, Ind. (June 26-July 6).
Greene, Tweed & Co., North Wales, Penna. (June 27-July 5—stand-by personnel).
Greising Engineering Co., Runnemede, N. J. (June 28-July 11).
Gro-Cord Rubber Co., Lima, Ohio (June 26-July 6).

## H

Haartz-Mason, Inc., Waterford, Mass. (June 29-July 6).
Hatfield Wire & Cable Co., Union & Hillside, N. J. (June 28-July 13).
Haynesville Mfg. Co., Haynesville, La. (June 28-July 13).
Hecht Rubber Co., Inc., Jacksonville, Fla. (July 1-July 14).
Henrite Products Corp., Ironton, Ohio (June 29-July 13).
Hershberg Rubber Products Co., Ashtabula, Ohio (June 26-July 12).
Heveatex Corp., Melrose, Mass. (June 26-July 10).
Hewitt-Robins, Inc., Stamford, Conn., Buffalo, N. Y., Fremont, Ohio and Franklin, N. J. (July 20-Aug. 3).
Hodgman Rubber Co., Framingham, Mass. (Aug. 3-Aug. 17).
Hofran, Inc., Tampa, Fla. (Aug. 1-Aug. 17).
Holland-Rantos Co., Inc., Trenton, N. J. (July 20-Aug. 3).
R. M. Hollingshead Corp., Camden, N. J. (July 3-July 19).
Hoover Hanes, Inc., Brooklyn, N. Y. (July 6-July 20).
E. F. Houghton & Co., Philadelphia, Penna. (July 4-July 13).
Houghton Vix-Syn Co., Hopkins, Minn. (July 4-July 13).
Huntingdon Industries, Inc., Bethayres, Penna. (Aug. 3-Aug. 10).
Huron Rubber Co., Norwalk, Ohio (June 27-July 6).

## I

Ideal Roller & Mfg. Co., Chicago, Ill., Long Island City, N. Y., Huntington Park, Calif., and Chamblee, Ga. (July 19-Aug. 3).
Ideal Tape, Inc., Lowell, Mass. (July 4-July 12).
Indiana Molding Co., Inc., Huntington, Ind. (June 27-July 6).
Industrial Filter & Pump Mfg. Co., Cicero, Ill. (July 3-July 20).
Industrial Rubber Corp., Brooklyn, N. Y. (July 2-July 14).
Irvington, Div., Minnesota Mining & Mfg. Co., Monrovia, Calif. (July 3-July 19).

## J

Jacobs Rubber Co., Danielson, Conn. (July 6-July 13).
Jasper Rubber Products, Inc., Jasper, Ind. (July 3-July 13).
Jenkin's Bros., Bridgeport, Conn. (July 13-Aug. 2).
Jewel-Sheen Coating, Inc., Long Island City, N. Y. (July 3-July 20).
Johnson & Johnson, Chicago, Ill. (July 17-Aug. 3).

## K

K & M Rubber Co., Maywood, Ill. (June 29-July 10).
Karmon Rubber Co., Akron, Ohio (July 3-July 13).
Karpex Mfg. Co., Inc., Indianapolis, Ind. (June 27-July 13).
Keaton Rubber Co., Kearny, N. J. (July 3-July 20).
Kentile, Inc., South Plainfield, N. J. (June 27-July 7).
I. B. Kleinert Rubber Co., New York, N. Y. (July 24-Aug. 10—Shipping will not be interrupted).
Kleistone Rubber Co., Inc., Warren, R. I. (July 3-July 20).

## L

Landers Corp., Toledo, Ohio (June 28-July 12).
Laurel Co., Garfield, N. J. (July 18-Aug. 3).
Lavelle Rubber Mfg. Corp., Burlington, Wisc. (July 11-July 26).
Lee Rubber & Tire Corp., Conshohocken, Penna. (Aug. 31-Sept. 7).
Ligonier Rubber Co., Ligonier, Ind. (June 29-July 6).
Lloyd Mfg. Co., Inc., Warwick, R. I. (July 3-July 20).
Lovell Mfg. Co., Erie, Penna. (July 24-Aug. 10).
Lubron Rubber Co., Everett, Mass. (July 3-July 20).
Luzerne Rubber Co., Trenton, N. J. (July 3-July 20).

## M

Magee Carpet Co., Bloomsburg, Penna. (June 27-July 13).
Major Chemical & Latex Corp., Boston, Mass. (July 4-July 13).
Manheim Mfg. & Belting Co., Manheim, Penna. (July 17-Aug. 3).
Mansfield Tire & Rubber Co., Mansfield, Ohio (June 28-July 5)
Martin Rubber Co., Inc., Long Branch, N. J. (July 24-Aug. 10).
Maytag Co., Newton, Iowa (July 3-July 20).
McCormick Rubber Co., Ridgefield Park, N. J. (July 27-Aug. 10).
McCreary Tire & Rubber Co., Indiana, Penna. (June 21-June 29).
Mechanical Rubber Products Co., Warwick, N. Y. (July 17-Aug. 3).
Mercer Rubber Co., Hamilton Square, N. J. (July 13-July 27).
Metasap Chemical Co., Harrison, N. J. (July 3-July 19); Cedartown, N. J. (Aug. 8-Aug. 23).
Middlesex Research Mfg. Co., Hudson, Mass. (July 3-July 20).
Mine Safety Appliances Co., Pittsburgh, Penna. (July 13-July 27).
Minnesota Rubber Co., Minneapolis, Minn. (June 26-July 14).
Mogul Rubber Corp., Goshen, Ind. (July 5-July 11).
Molded Rubber & Plastic Corp., Milwaukee, Wisc. (July 25-Aug. 10).
Monet Co., Fanwood, N. J. (July 1-July 15).
Monroe Auto Equipment Co., Hillsdale, Mich. (June 26-July 6).
Mystik Adhesive Products, Inc., Chicago, Ill. (July 3-July 17).

## N

Narragansett Wire Co., Pawtucket, R. I. (July 17-Aug. 3).
National Cash Register Co., Dalton, Ohio (Aug. 3-Aug. 24).
New England Tape Co., Hudson, Mass. (Aug. 1-Aug. 15).
New Jersey Rubber Co., Taunton, Mass. (June 27-July 13).
New Jersey Wood Finishing Co., Woodbridge, N. J. (July 4-July 20).
New York Rubber Corp., Beacon, N. Y. (June 29-July 6).
Newth Rubber Co., Barrington, R. I. (June 26-July 13).
Nichols Engineering, Inc., Shelton, Conn. (July 31-Aug. 17).
Nopco Chemical Co., Plastics Div., North Arlington, N. J. (July 3-July 19); Cedartown, N. J. (Aug. 8-Aug. 23).

## O

Odell Co., Watertown, Mass. (June 30-July 6).
Okonite Co., Paterson, Passaic, and North Brunswick, N. J. (July 6-July 19).
O'Sullivan Rubber Corp., Rubber Div., Winchester, Va. (June 27-July 6).

## P

Pacific Latex Co., Los Angeles, Calif. (July 4-July 12).
Paeco Rubber Co., Ravenna, Ohio (July 3-July 13).
Pantasote Co., Passaic, N. J. (July 6-July 13).
Paragon Rubber Corp., Easthampton, Mass. (July 4-July 13).
Paramount Foam Industries, Ridgefield, N. J. (June 30-July 4).
Parker Stearns & Co., Inc., Brooklyn, N. Y. (July 3-July 19).
Passaic Rubber Co., Clifton, N. J. (July 10-July 26).
Paul-Martin Rubber Corp., Holyoke, Mass. (July 10-July 20).
Pawling Rubber Corp., Pawling, N. Y. (July 13-July 19—Partial Production weeks of July 6th and July 20th).
Permacel, New Brunswick, N. J. (July 19-July 26—Plant only, office will be open).
Pierce-Roberts Rubber Co., Trenton, N. J. (July 24-Aug. 10).
Pilot Packing Co., Inc., New York, N. Y. (July 17-Aug. 3).
Pioneer Rubber Co., Willard, Ohio (June 27-July 13).
Plabell Rubber Products, Inc., Toledo, Ohio (July 6-July 13).
Plasticoid Co., Elkton, Md. (July 13-July 20).
Plymouth Rubber Co., Inc., Canton and Rockland, Mass. (June 28-July 6).
Ponn Machine Cutting Co., Everett, Mass. (July 3-July 20).
H. K. Porter Co., Inc., Nephi Works, Nephi, Utah (July 26-Aug. 1; Oct. 25-Nov. 1); Ridbo Works, Danville, Ill. (June 29-July 13); Thermoid Div., Trenton, N. J. (Aug. 24-Sept. 7).
Precision Rubber Products Corp., Dayton, Ohio (Aug. 3-Aug. 9—Partial shutdown week of Aug. 10).
Precision Thread Co., Inc., Fall River, Mass. (July 4-July 12).
Premier Rubber Mfg. Co., Dayton, Ohio (June 27-July 12).
Premoid Corp., West Springfield, Mass. (June 20-July 6).
Pretty Products, Inc., Coshocton, Ohio (July 27-Aug. 10).
Princeton Knitting Mills, Inc., Watertown, Conn. (July 3-July 13).
Pulaski Rubber Co., Akron, Ohio (July 11-July 20).

## R

Rainfair, Inc., Racine, Wisc. (June 26-July 13).
Randolph Mfg. Co., Randolph, Mass. (June 27-July 11).
Raybestos-Manhattan, Inc., General Asbestos & Rubber Div., North Charleston, S. C. (June 29-July 13); Manhattan Rubber Div., Passaic, N. J. (July 27-Aug. 10); Raybestos Div., Stratford, Conn. (July 20-July 27); United States Asbestos Div., Manheim, Penna. (July 6-July 13); Wabash Div., Crawfordsville, Ind. (July 6-July 20).
R.C.A. Rubber Co., Akron, Ohio (June 27-July 13).
Red Raven Rubber Co., Newark, N. J. (July 3-July 14).
Reiss Mfg. Corp., Rway Synthetic Products Div., Little Falls, N. J. (Aug. 10-Aug. 14).
Rhee Elastic Thread Corp., Warren, R. I. (July 3-July 20).
Ridbo Laboratories, Inc., Danville, Ill. (June 29-July 5—Limited operation July 6-July 13).
Robert Toledo Rubber Co., Toledo, Ohio (July 4-July 12).
Rodale Mfg. Co., Inc., Emmaus, Penna. (June 26-July 13).
Rodic Chemical & Rubber Corp., New Brunswick, N. J. (July 27-Aug. 10).
Rogers Corp., Rogers, Conn., Rogers Div. (July 27-Aug. 9); Killingly Div. (July 27-Aug. 9); Willimantic Div. (July 27-Aug. 9); Manchester Div. (June 29-July 12).

Ross & Roberts, Inc., Stratford, Conn. (June 28-July 12).
Roth Rubber Co., Cicero, Ill. (July 20-July 31).
Royal Electric Corp., Pawtucket, R. I. (June 27-July 12).
Rubatex Div., G.A.F., Inc., Bedford, Va. (July 5-July 12).
Rubber Corporation of Amercia, Long Island, N. Y. (June 27-July 12).
Rubber Corporation of Pennsylvania, West Hazleton, Penna. (June 27-July 5).
Rubber Covered Products Co., Inc., Pawtucket, R. I. (Aug. 3-Aug. 17).
Rubber Fabricators, Inc., Grantsville, West Va. (July 3-July 13).
Rubber Latex Co. of America, Clifton, N. J. (July 4-July 12).

S

W. H. Salisbury & Co., Chicago, Ill. (June 28-July 19).
Sandura Co., Fullerton, Penna. (July 3-July 12).
Sawyer-Tower, Inc., Watertown, Mass. (July 6-July 18).
Scandinavia Belting Co., Charlotte, N. C. (June 26-July 13).
Frank G. Schenuit Rubber Co., Baltimore, Md. (Aug. 3-Aug. 17).
Julius Schmid, Inc., New York, N. Y. and West Paterson, N. J. (Aug. 17-Aug. 29).
Seaboard Chemicals, Inc., Salem, Mass. (June 29-July 13).
Seamless Rubber Co., New Haven, Conn. (Aug. 3-Aug. 17).
Seiberling Latex Products, New Bremer, Ohio (July 3-July 13).
Servus Rubber Co., Rock Island, Ill. (July 13-Aug. 3).
Shawsheen Rubber Co., Inc., Ballard Vale, Mass. (July 4-July 13).
Simplex Wire & Cable Co., Cambridge, Mass. (July 13-July 26); Submarine Cable Div., Newington, N. H. (July 6-July 19).
Skippy Footwear Corp., West Hazleton, Penna. (June 27-July 5).
Slomons Laboratories, Inc., Long Island City, N. Y. (July 3-July 13).
Albert D. Smith & Co., Smith Textile Div., Wilmington, Del. and Staten Island, N. Y. (July 4-July 19).
M. L. Snyder & Son, Inc., Philadelphia, Penna. (July 3-July 21).
South Haven Rubber Co., South Haven, Mich. (June 29-July 6).
Southeastern Rubber Mfg. Co., Athens, Ga. (July 4-July 12).
Sperry Rubber & Plastics Co., Brookville, Ind., Milk Tubing Dept. (June 21-July 5); Plastics Dept. (June 28-July 12); Tooling and Development (June 28-July 12).
Stalwart Rubber Co., Bedford, Ohio (June 29-July 13).
Standard Insulation Co., Inc., East Rutherford, N. J. (July 6-July 13).
Stokes Molded Products, Trenton, N. J. (July 6-July 13).
Stowe-Woodward, Inc., Massachusetts Div., Newton Upper Falls, Mass. (Aug. 3-Aug. 16).
Suflex Corp., Woodside, N. Y. (July 19-Aug. 3).
Surety Rubber Co., Carrollton, Ohio (June 27-July 6).
Surprenant Mfg. Co., Boston and Clinton, Mass. (July 3-July 20).
Swan Rubber Co., Bucyrus, Ohio (July 18-Aug. 1); Carey, Ohio (June 27-July 11).
Synthon, Inc., Cambridge, Mass. (July 3-July 13).
Syracuse Rubber Products Co., Inc., Syracuse, Ind. (July 5-July 13).

T

T & M Rubber Specialties Co., Inc., Goshen, Ind. (July 3-July 13).
Tanide Products Corp., Malden, Mass. (July 6-July 20).
Taylor Brothers Co., Cleveland, Ohio (June 27-July 6).
Technical Industries, Inc., Wakefield, R. I. (July 3-July 20).
Technical Specialties Co., New York, N. Y. (June 29-July 10).
Technical Tape Corp., New Rochelle, N. Y. (June 29-July 13).
Tigron Latex & Chemical Corp., Stoughton, Mass. (June 29-July 5).
Timme Corp., Wilmington, N. C. (June 27-July 6).
Tingley Rubber Corp., Rahway, N. J. (July 13-July 26).
Tompkins Rubber Co., Plymouth Meeting, Penna. (July 1-July 19).
Toyad Corp., Latrobe, Penna. (July 17-Aug. 3).
Triangle Conduit & Cable, Inc., New Brunswick, N. J. (July 4-July 20).
Tyer Rubber Co., Andover, Mass. (July 10-July 27).

U

UBS Chemical Corp., Cambridge, Mass. (June 29-July 13).
U. S. Rubber Co., Chicopee Falls, Mass. (Aug. 10-Aug. 23); Detroit, Mich. (July 27-Aug. 10); Eau Claire, Wisc. (Aug. 3-Aug. 16); Indianapolis, Ind. (July 20-Aug. 2); Los Angeles, Calif. (Aug. 17-Aug. 30); Passaic, N. J. (July 20-Aug. 3).
U. S. Rubber Reclaiming Co., Inc., Buffalo and Cheektowaga, N. Y. (Aug. 16-Sept. 1).

V

Varflex Corp., Rome, N. Y. (July 3-July 18).
Varflex Sales Co., Inc., Rome, N. Y. (July 3-July 18).
Venus Pen & Pencil Corp., Hoboken, N. J. (July 20-Aug. 3).
Victor Balata & Textile Belting Co., Inc., Easton, Penna. (July 27-Aug. 3).
Victor Mfg. & Gasket Co., Chicago, Ill. (July 10-July 26).
Victor Rubber Corp., Gettysburg, Penna. (June 26-July 6).
Virginia Chemical Corp., Lynchburg, Va. (June 29-July 6).
W. J. Voit Rubber Corp., Los Angeles, Calif. (June 27-July 12—Offices will be open).
Vulcan Rubber Products Div., Reeves Brothers, Inc., Buena Vista, Va. (June 29-July 5).
Vulcanized Rubber & Plastics Co., Morrisville, Penna. (July 19-Aug. 3).

W

Wadsworth & Woodman Div., Interchemical Corp., Winthrop, Maine (July 3-July 19).
Walker Bros., Conshohocken, Penna. (July 5-July 12; Aug. 2-Aug. 9).
Waukesha Rubber Co., Waukesha, Wisc. (July 3-July 20).
Weldon Roberts Rubber Co., Newark, N. J. (July 3-July 18).
Wellco Shoe Corp., Waynesville, N. C. (June 29-July 12).
West Co., Millville, N. J. (July 13-July 27); Phoenixville, Penna. (Aug. 10-Aug. 24).
Western Rubber Co., Goshen, Ind. (July 24-Aug. 3).
S. S. White Dental Mfg. Co., Philadelphia, Penna., and Staten Island, N. Y. (July 6-July 13).
White Rubber Co., Ravenna, Ohio (June 27-July 12).
Williams-Bowman Rubber Co., Cicero, Ill. (July 2-July 20).
Williamson Adhesives, Inc., Skokie, Ill. (July 10-July 24).
Wilson Rubber Co., Canton, Ohio (June 29-July 13).
Windram Mfg. Co., South Boston, Mass. (July 4-July 13).
World Bestos Div., Firestone Tire & Rubber Co., New Castle, Ind. (June 28-July 7).

Y

Youngs Rubber Corp., Trenton, N. J. (July 20-Aug. 3).

## Canada

A

Acton Rubber Ltd., P.Q. (July 17-Aug. 2).
American Biltrite Rubber Co. (Canada), Ltd., Que. (July 4-July 20).
American Wringer Co., Que. (July 18-Aug. 2).
Armet Industries, Ltd., Ont. (July 25-Aug. 11).
Asbestonos Corp., Ltd., P.Q. (July 20-July 31).

B

Bata Shoe Co. of Canada, Ltd., Ont. (July 14-Aug. 4).
Bauers, Ltd., Ont. (Aug. 2-Aug. 15).
Borden Chemical Co. (Canada), Ltd., Ont. (July 6-July 12).
British Rubber Co., Ltd., Que. (July 13-July 25).

C

Canadian General-Tower, Ltd., Ont. (July 18-Aug. 4).
Canadian Lastex, Ltd., Que. (July 19—Tentative to Aug. 2).
Canadian Technical Tape, Ltd., Ont. & Que. (July 26-Aug. 2).
Continental Rubber, Ltd., Alberta (July 6-July 18)

D

Dominion Rubber Co., Ltd., Dominion Tire Factory, Kitchener, Ont. (Aug. 9-Aug. 23); Latex & Reclaim Div., Montreal, Que.—Solvents Div. (July 19-Aug. 2) and Lotol and Reclaim Div. (Aug. 2-Aug. 16); Merchants Rubber Factory, Kitchener, Ont.—Footwear, Sponge & Metal Last (June 26-July 14) and Foam and General Products (July 26-Aug. 9); Naugatuck Chemicals Div., Elmira, Ont. (Aug. 2-Aug. 16); Rubber Machinery Shops, Kitchener, Ont. (July 19-Aug. 2); St. Jerome Factory, St. Jerome, Que. (June 28-July 12); Textile Div., Kitchener, Ont. (July 19-Aug. 2).
Dominion Silk Mills, Ltd., Fabricushon Div., Ont. (July 18-Aug. 3).
Dunlop Canada, Ltd., Ont. (July 25-Aug. 11).

G

General Tire & Rubber Co. of Canada, Ltd., Industrial Products Div., Ont. (July 25-Aug. 9).
B. F. Goodrich Sponge Products Canada, Ltd., Que. (July 17-July 27).
Goodyear Tire & Rubber Co. of Canada, Ltd., Que. (July 13-July 27).
Granby Elastic & Textiles, Ltd., P.Q. (July 19-Aug. 3).
Gutta Percha & Rubber, Ltd., Ont. (July 20-Aug. 4).

J

Johnson & Johnson, Ltd., Que. (July 27-Aug. 10).

K

Kaufman Rubber Co., Ltd., Ont. (July 18-Aug. 3).

L

Lion Rubber & Plastics, Ltd., Que. (July 18-July 27).

M

Mansfield Rubber (Canada), Ltd., Ont. (July 25-Aug. 4).
Mine Safety Appliances Co. of Canada, Ltd., Ont. (July 11-July 26).
Minnesota Mining & Mfg. Co., Ont. (July 20-Aug. 4).

N

Northern Electric Co., Ltd., Que. (July 13-July 24).

P

Phillips Electrical Co., Ltd., Brockville, Ont.; Montreal, P.Q.; Vancouver, B.C. (July 17-Aug. 4).
Pierce & Stevens Canada, Ltd., Ont. (July 25-Aug. 9).

R

W. Ralston & Co. (Canada) Ltd., Que. (July 26-Aug. 2).
Raybestos-Manhattan (Canada), Ltd., Ont. (July 18-Aug. 4).
Robinson Foams, Ltd., Ont. (July 20-Aug. 4).
Robinson Moulded Products, Ltd., Ont. (July 20-Aug. 4).
Rubbermaid (Canada), Ltd., Ont. (July 24-Aug. 4).

S

St. Lawrence Rubber Co., Que. (July 18-Aug. 3).
Seiberling Rubber Co. of Canada, Ltd., Ont. (Aug. 10-Aug. 24).
M. L. Snyder & Son, Ltd., Woodbridge, Ont. (July 18-Aug. 3).
Sterling Rubber Co., Ltd., Ont. (July 26-Aug. 1).
Super Oil Seal Mfg. Co., Ltd., Ont. (Aug. 1-Aug. 16).

T

Tillotson Rubber Co., Ltd., Que. (Aug. 1-Aug. 17).

V

Victory Manufacturing Co., Ltd., Ont. (July 11-July 26).

W

Woodbridge Rubber Works, Woodbridge, Ont. (July 18-Aug. 3).
F. E. Woodward & Sons, Ltd., Que. (July 10-July 20).

Y

Yale Rubber Mfg. Co., Ltd., Ont. (July 27-Aug.

# Rhode Island Rubber Club Celebrates 25th Anniversary With Gala Outing

► The Rhode Island Rubber Club celebrated its Twenty-Fifth Anniversary with a gala week-end outing held on June 12 to 14 at the Hotel Belmont at West Harwich (Cape Cod), Mass. Approximately 160 members and their wives participated in a program which began Friday afternoon, June 12, extending through Sunday dinner on June 14.

### *Outlines Week-End Program*

Friday afternoon and Saturday were spent in golfing. At dinner on Friday evening H. W. Day (DuPont), chairman of the Rhode Island Rubber Club, delivered welcoming remarks and W. K. Priestley (Kaiser Aluminum), general chairman of the Outing Committee, outlined the program planned for the week-end. Following dinner, a program of songs was presented by the "Chem-Tones," a group of singing chemists composed of Arthur J. Peros (Goodrich-Chemical), bass; Arthur E. Nelson (Goodrich-Watertown), tenor; Henry A. Johnson (Goodrich-Watertown), baritone; and Robert J. Ingraham (Thiokol), tenor. Mr. Peros serves as musical director of the group. After-dinner entertainment was also provided by Dr. Stanley Jaks, who presented a program entitled "Curiosities of the Mind."

Following breakfast on Saturday morning, June 13, members participated in a golf tournament, a tennis tournament or went deep sea fishing. The ladies, meanwhile, participated in a "get acquainted" coffee hour. Members and guests who were so inclined also made use of the beach facilities. The weather, unfortunately, was not cooperative.

### *Golf Tournament Winners*

The golf tournament was held at the Bass River Golf Club with the following winners: *Low Gross*—Richard Steinmetz (United Carbon); *Low Net*—J. H. Milner (Ansonia Wire); *2nd Low Net*—William Maguire (United Carbon); *Blind Bogey*—W. K. Priestley (Kaiser Aluminum); *2nd Blind Bogey*—Ralph Robitaille (Phillips Chemical); *3rd Blind Bogey*—B. Bradley (Griswold Rubber); *Nearest to Pin*—Ray Szulik (Acushnet Process); *2nd Nearest to Pin*—W. J. Curtin (Naugatuck Chemical); *3rd Nearest to Pin*—Anthony Laugelle (Superior Motor); *Putting*—H. W. Day (DuPont); *Longest Drive*—Connie Lyons (Rubber Corp. of America).

In the women's golf tournament, Mrs. P. Bradley, whose husband is associated with Griswold Rubber, had low net, while Mrs. Al Stohlman, whose husband is affiliated with Enjay, had low gross.

In the tennis tournament, Bert Stohlman (Enjay) took top honors. Second prize went to Mrs. John Hussey, whose husband is associated with Goodyear, and third prize went to Steve Tyng (U. S. Rubber).

Another feature of the day was a bridge tournament at which Mrs. Roger Stellar, whose husband is associated with Goodrich, won first prize. Mrs. John Tronson, whose husband is affiliated with R. T. Vanderbilt, won second prize.

### *Saturday Evening Festivities*

The evening activities on Saturday, June 13, began with a cocktail party. This was followed by an excellent dinner at which Mr. Day served as toastmaster. Some 220 members and guests attended the dinner. Mr. Day introduced those sitting on the dais, including George Popp (Phillips Chemical), treasurer of the Division of Rubber Chemistry of the American Chemical Society. In brief remarks, Mr. Popp extended the greetings of the Rubber Division to the assembled members and guests of the Rhode Island Rubber Club.

Mr. Day then introduced several past-chairmen of the group who were in attendance at the meeting, all of whom were presented with a gift. Those honored included Ezra L. Hanna (1938), Frederick S. Bartlett (1950), C. Leigh Kingsford (1952), Urban J. H. Malo (1955), Gilbert E. Enser (1957), Roy G. Volkman (1953), Raymond Szulik (1956), and W. Kenneth Priestley (1958).

Mr. Priestley, in his capacity as general chairman of the Outing Committee, thanked all those who had contributed to the success of the outing. These included the following:

*Solicitation Committee*—U. J. H. Malo (Narragansett Wire), E. C. Uhlig (U. S. Rubber), F. Catalfano (Bristol Mfg.), C. M. Antonio (U. S. Rubber), J. Corangelo (U. S. Rubber), D. D'Aguanno (Apex Tire), G. Smith (Kaiser Aluminum), J. G. Cullen (Marbon), K. Vale (Grinnell), J. J. Cooney (U. S. Rubber), R. Robitaille (Phillips Chemical), J. Potter (Apex Tire), C. Stoeckle (Firestone), T. Johnson (Kaiser Aluminum), G. Covington (Phillips Chemical) and G. Royle (Atlantic Tubing). Mr. Uhlig served as chairman of this committee.

*Publicity Committee*—Frank Gerardi (Crescent Wire), Joseph Vitale (Crescent Wire) and Roy Volkman (U. S. Rubber). Mr. Volkman served as chairman of this committee.

*Daytime Program Committee*—R. Daley (General Tire), R. Loveland (R. T. Vanderbilt), W. A. Maguire (United Carbon), R. W. Szulik (Acushnet Process), E. Damicone (Acushnet Process) and J. Arnold (Enjay). Mr. Szulik headed this group.

*Arrangements Committee*—J. Edenbaum (Davol Rubber), J. Gagne (Davol Rubber), W. J. Blecharczyk (Davol Rubber), J. M. Donahue (Goodyear) and R. Van Amburgh (Davol Rubber). Mr. Blecharczyk served as chairman of the Arrangements Committee.

*Evening Program Committee*—Mr. Day served as chairman of this group which included Harry Ebert (Firestone).

The after-dinner speaker at the banquet was Lieutenant Commander Charles S. Carlisle, USN, who showed a motion picture depicting the voyage of the submarine *S.S. Sea Wolf* under the Arctic ice pack. The speaker described the life of the submariner in his talk on the "Conquest of Inner Space," and stated that the United States is ahead in the vital field of nuclear powered undersea craft.

### *Silver Anniversary Ball*

The Saturday evening festivities concluded with a Silver Anniversary Ball. Activities on Sunday, June 14, included a breakfast and a luncheon session attended by many members and guests.

The Rhode Island Rubber Club issued a special 60-page booklet commemorating its 25th Anniversary which includes an extensive and interesting history of the organization from the date of its founding to the present.

The photographs which appear on the facing page, exclusively arranged for by RUBBER AGE, show members and guests of the Rhode Island Rubber Club at various stages of the Twenty-Fifth Anniversary Celebration Outing.

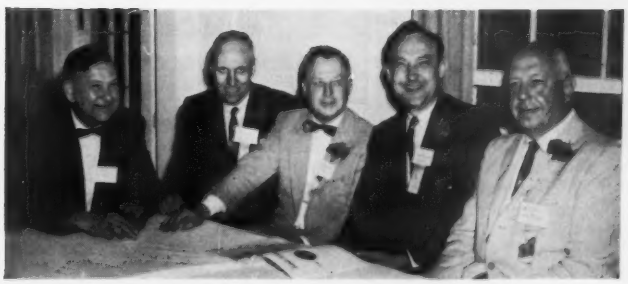
# Seen at the Rhode Island Club Anniversary Celebration

The dais at the banquet on Saturday evening included group officers and their wives and honored guests.

H. "Web" Day (DuPont), chairman of the Rhode Island Rubber Club (left), conversing with ACS Rubber Division Treasurer, George Popp.

An informal group chatting in the cocktail lounge of the Belmont Hotel included (left to right), M. E. Lerner (RUBBER AGE), Mrs. William Pierpont, Herbert J. Due (St. Joseph Lead), Mrs. Lerner, Mr. Pierpont (American Synthetic Rubber) and Mrs. Due.

The Silver Anniversary Ball was a highlite of the three-day week-end. Some of those tripping the light fantastic can be seen in this photograph. Dr. B. S. Garvey, Jr. (Pennsalt Chemicals) and his charming wife, Betty, are seen in direct center.



The key planners of the Anniversary Outing included, left to right, E. C. Uhlig (U. S. Rubber), Roy Volkman (U. S. Rubber), Web Day (DuPont), Ray Szulik (Acushnet Process) and Ken Priestley (Kaiser Aluminum). A good deal of the credit for a most successful affair goes to these individuals.

## Dow Corning Introduces New Silicone Rubber Compounds

► Dow Corning Corp., Midland, Mich., introduced several new silicone rubber compounds for a variety of applications at a special press conference held recently in New York City. The first is a fuel and solvent resistant silicone rubber masterbatch identified as Silastic LS-422 Base. This masterbatch, composed of a fluorosilicone polymer and reinforcing silica, permits the design of fluorosilicone compounds with physical and solvent resistant properties appropriate to a specific application.

Because it readily accepts additional fillers, compounds up to 80 durometer (Shore A hardness) can be formulated. According to the company, stocks compounded from the LS-422 Base are easily processed by molding, extruding, calendering and dispersion coating. The masterbatch is translucent in color and has low volume swell after immersion in jet fuels, solvents and hydraulic oils.

Silastic 433 Base is a silicone polymer with a quantity of reinforcing silica added which also readily accepts additional fillers, permitting formulation of compounds up to 80 durometer (Shore A). Stocks compounded from this base process easily and efficiently and are said to release readily from mill rolls without the need for a scraper blade. Also, heat stability additives are not necessary to formulate stocks with good heat resistance. Many compounds which have custom properties for specific applications may be compounded from this material. Silastic 433 is translucent in color.

*General Purpose Compounds*

Two general purpose compounds in the Silastic 50 and 80 series, Silastic 52 and Silastic 82, are 50 and 80 durometer (Shore A Hardness) stocks than can be blended to obtain any intermediate hardness. Easy to process, these two new stocks release from mill rolls without the use of scraper blades and feed into extruders easily. High green strength aids in the production of unsupported sheets without ripping or tearing. Maximum heat stability is evidenced by retention of flexibility even after several days exposure at 600°F., Dow Corning States. The company supplies these materials in uncatalyzed form as Silastic 52U and Silastic 82U.

A new easy to process fuel, solvent and oil resistant fluorosilicone rubber, Silastic LS-63U, permits manufacture of parts by all conventional means of fabrication such as molding, extruding, calendering and dispersion coating. Silastic LS-63U is serviceable at both extremely high and extremely low temperatures and exhibits very low volume swell and little physical property change when immersed in jet fuels and hydraulic oils. White in color, the new rubber may be pigmented to any desired shade. It is also easily processed. Dow Corning will also ship Silastic LS-62 catalyzed with 2, 4 dichlorobenzoyl peroxide.

A new silicone rubber compound intended specifically for wire and cable insulation is said to meet the need for more easily extruded silicone rubber stocks. The new material requires no mill freshening prior to extrusion. Packaging is in hats or strips ready for direct feeding from the shipping container into the extruder.

Silastic 1601 meet the requirements of insulation for Underwriters Laboratories Standards for 200 C rated fixture and appliance wire. Faster extrusion rates and dense, homogeneous insulating walls without post-cure are other advantages of this material. Silastic 1601 maintains its electrical properties at high temperatures and remains flexible over a wide temperature range, according to Dow Corning.

Another easy to process silicone rubber compound for wire and cable manufacture has been designed for cable constructions which demand a combination of good physical and electrical properties and excellent heat resistance. Silastic 1602 has easy processing characteristics which permit manufacture of dense homogeneous thin walled cable insulation. The new material releases readily from mill rolls without the use of scraper blades.

Silastic 1602 is recommended for cable constructions outlined in MIL-W-8777 Aircraft cable, MIL-19381 Nuclear Shipboard cable and MIL-W-16878 hook-up wire. Tan in color, the new compound is easily pigmented for color coding. The company will supply the material in uncatalyzed form as Silastic 1602U.

Dow Corning has also announced a new price reduction for Silastic LS-53, the fuel and solvent resistant silicone rubber. This reduction brings Silastic LS-53 prices to a starting level of $16.00 per pound. The new additions to the LS series of fuel solvent and oil resistant fluorosilicones, Silastic LS-63 and Silcastic LS-63U are available at the same price.

## Develops New Resin

► Schenectady Varnish Co., Schenectady, N. Y., has announced the development of a new bromo-methyl alkylated phenol-formaldehyde resin which is reported to reduce the cure time of butyl rubber and to provide improved heat resistance and compression set properties. According to the company, the new resin, designated SP-1055 Resin, makes it possible to cure butyl rubber in 10 to 60 minute cycles at temperatures of 300 to 350°F. Unlike present resin curing systems, no catalyst is required to effect the cure of butyl rubber with SP-1055 Resin, the company states. The resin is said to make possible the production of butyl rubber parts capable of withstanding exposure to temperatures up to 500°F. for long periods, without losing its resiliency.

## G-E Polycarbonate Resin Plant

► Chemical Materials Department of the General Electric Co., Pittsfield, Mass., has announced the acquisition of land and plans to build a commercial plant for the production of Lexan polycarbonate resin. According to the company, a 160 acre site has been selected, which is located on the Ohio River southwest of Mount Vernon, Ind. It is reported that engineering plans for the plant are being completed and it is expected that orders for the structural steel will be placed shortly. The company anticipates production at the new plant to begin some time during the next year.

## Borden Appoints Vice-President

► Borden Chemical Co., New York, N. Y., has announced the appointment of Harry C. Wechsler as a vice-president responsible for the development of various plastic projects. Mr. Wechsler will retain his present duties as general manager of Borden's Polyvinyl Chloride Department at Leominster, Mass. He began his career as a chemistry instructor at St. Francis College in Brooklyn, N. Y. and gave up teaching in 1948 to become research chemist for the Eastern Development Co. Mr. Wechsler was chief chemist when he left in 1950 to become technical adviser to the Manufacturers' Association for the State of Israel. He was project leader for DeBell and Richardson, Inc. from 1951 to 1953, when he joined American Monomer Corp. When Borden acquired American Monomer in 1955, Mr. Wechsler joined the company and was assigned the task of organizing the Polyvinyl Chloride Department of the company.

## Aerojet-General To Offer Stock

► Aerojet-General Corp., Azusa, Calif., has filed a registration statement with the Securities and Exchange Commission for 175,000 shares of common stock to be offered for public sale through an underwriting group headed by Kidder, Peabody & Co. According to the company, the proceeds from the sale of the stock will be used to repay $14 million of advances from the General Tire & Rubber Co., Akron, Ohio.

## West Coast News

► Production of tread rubber at the Los Angeles plant of the B. F. Goodrich Tire Co. has been increased 300 per cent as the result of the installation of a new manufacturing unit, according to the company. The $300,000 unit, which boosted the plant's capacity to 50,000 pounds daily, is 142 feet long and comprises two mixing mills, an extruder, and a series of stock cooling chambers. It is said to make possible more efficient operation and better control of product quality in addition to a greater daily output.

► D. W. Anderson has been appointed to the new post of sales promotion manager for the Los Angeles Tread Rubber Division of the W. J. Voit Rubber Co. Mr. Anderson was formerly manager of the Automatic Controls Division of the Clary Corp. and previous to that, he held sales and management posts with the Firestone Tire and Rubber Co. A graduate of Purdue University with a B.S. degree in engineering, Mr. Anderson has devoted 25 years to engineering, sales and management in the rubber industry.

► Vincent L. Murphy, formerly with the Dow Chemical Co., has been named general manager of the Compounding Division for the Ellay Rubber Co., Inc., and Maineline Sales Co., both of Los Angeles, Calif. Mr. Murphy, a graduate of Harvard University, has been associated with the plastics industry in Southern California for the past 12 years.

► Ray Hartman, formerly a laboratory technician, has been promoted to the Marketing Department of the Shell Chemical Corp., Torrance, Calif.

► Leonard Rose has joined the sales staff of the C-L Chemical Products Co.

## Canadian News

► At the annual meeting of the Rubber Association of Canada, it was forecast that 93,500 long tons of new Canadian rubber will be used in 1959, an increase of 11½ per cent over 1958 and more than two per cent over the 1956 record year. Statistics for 1959, to date, indicate that tire sales should climb to a new and substantially higher peak with truck tire sales showing the highest percentage increases.

Sales in the mechanical goods and heel and sole sectors also indicate that 1959 should show an improvement over 1958. However, with the recent Tariff Board report on rubber footwear "having given the green light to the low wage cost producer in Hong Kong, Japan, India, Communist China and Communist Czechoslovakia," the Canadian footwear industry is expected to face another bleak year.

Noteworthy developments in the industry during 1958 were: (1) a fall in rubber consumption to slightly less than the 1955 level; (2) an increase in total tire sales to a new peak; (3) publication of the Second Tariff Board Rubber Footwear Report, which denied the industry relief from import competition; (4) increased imports of rubber footwear from Hong Kong, Japan, Czechoslovakia and to a lesser extent, Communist China; (5) increased imports of rubber clothing from Hong Kong and Japan; and (6) Tariff Board hearings on a wide range of textile products, which are said to be among the most important raw materials of the rubber industry.

During the meeting, J. P. Anderson, president and general manager of Dunlop Canada, Ltd., was re-elected president of the Association. Other elections include *Vice-president*, C. E. Joslin (American Biltrite); *Treasurer*, W. H. Mason (Seiberling); and *Manager and Secretary*, Greig B. Smith. Other members of the board of directors are R. H. Mallory, T. M. Mayberry, John Miner, J. B. Prendergast, T. Rosser, L. E. Spencer, C. C. Thackray and R. V. Yohe.

► C. M. Roberts has been appointed manager of the Manufacturers' Sales Division of the Goodyear Tire & Rubber Co. of Canada Ltd., succeeding A. E. Grainger, who has been appointed executive assistant. Mr. Roberts, formerly manager of the company's Truck and Farm Tire Department, has also served as manager of the Automobile Tire Department, and with the Calgary and Vancouver sales branches. Mr. Grainger, manager of manufacturers sales for 31 years, joined Goodyear in 1915 and served in various clerical and sales capacities until he was appointed manager in 1928.

Goodyear has also announced plans to build a $7,000,000 plant in Western Canada for the production of truck and farm tires. Location of the new plant, which will supply dealers from the Lakehead to the West Coast, will be decided within the next year, according to a company spokesman.

► Naugatuck Chemicals Division of the Dominion Rubber Co., Ltd., has appointed James A. Cruckshank as general sales manager, with headquarters in Elmira, Ont. Mr. Cruckshank joined Naugatuck Chemicals in technical sales in 1946; was made Eastern Canada agricultural sales manager in 1949; and was promoted to assistant general sales manager in 1953. He is an active member of the Chemical Institute of Canada and is secretary-treasurer of the Elmira Board of Trade.

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## Vulcanization Accelerators

► Rubber Chemicals Department of the American Cyanamid Co., New York, N.Y., has announced that five rubber vulcanization accelerators useful for latex and butyl compounding are now available. According to Cyanamid, these products range in activity from the very fast thiuram sulfides and dithiocarbamates to the moderately fast zinc mercaptobenzothiazole. The company reports that two zinc dithiocarbamate ultra accelerators, zinc dibutyldithiocarbamate and zinc diethyldithiocarbamate, are being marketed to latex users under the respective trademarks, Cyzate B and Cyzate E ultra accelerators. Both products are water dispersions containing 50 per cent solids.

Also of interest to latex compounders is zinc mercaptobenzothiazole, which is being sold as ZMBT. ZMBT, which supplements Cyanamid's line of thiazole accelerators, is vacuum-packed and palletized to facilitate handling, minimize tear risks and reduce required storage space, the company states. The monosulfide and disulfide of tetramethylthiuram are available in both powder and pellet form as Cyuram MS and Cyuram DS ultra accelerators. These products, together with MBT and MBTS, represent the beginning of a Cyanamid rubber chemicals line for butyl compounds, the company reports.

## Fire at Food Machinery Plant

► A fire, which started when chemical fumes escaped from a distillation unit into the atmosphere, recently took place at the Nitro, West Va., plant of the Chemicals & Plastics Division of Food Machinery Corp. Confined to the middle section of the plasticizer building, the fire damaged approximately one-half of the building. The company reports that two employees suffered minor injuries. No significant interruption in production or delivery of products is anticipated since the miscellaneous plasticizers produced in equipment damaged by the fire will temporarily be made in spare facilities which are located in other portions of the plant. Facilities producing Dapon resin, aluminum chloride and other products were not affected.

## To Buy Petrochemical Company

► Signal Oil and Gas Co. has announced that it is completing plans for the acquisition of Eastern States Petroleum and Chemical Corp. of Houston, Texas. Terms of the purchase were not disclosed, but it was reported that the agreement provides for an exchange of stock. The acquisition would give Signal Oil a 60,000 barrel refinery, a petrochemical plant and research center, deep water marine terminals, and a interest in the Rancho pipeline which extends from West Texas to Houston.

# NAMES
## in the news

**Richard I. DeVine,** general sales manager for viscose fibers of all divisions of Beaunit Mills, Inc., has been named chairman of the Merchandising Advisory Committee of Tyrex Inc.

**Lyle L. Shepard,** president of the Columbian Carbon Co., has been appointed chairman of the Commercial Unit in the publicly-owned Corporations Division of the Greater New York Fund's 1959 campaign.

**Dr. Frank K. Schoenfeld,** vice-president of research and development for the B. F. Goodrich Co., has been awarded the 1959 Medal of Honor by the Industry Research Institute, Inc., for "outstanding accomplishment in leadership in or management of industrial research which contributes broadly to the development of industry or the public welfare."

**David Slohm** has been appointed to the sales engineering staff of the First Machinery Corp. and of its subsidiary company, the Falcon Manufacturing Division.

**Dr. Marvin Lehr** has joined the Chemical Research Department of the B. F. Goodrich Co. Research Center in Brecksville, Ohio, where he will work on polymers.

**Paul A. Frank,** president of the National Rubber Machinery Co., has been elected president of the Akron Community Trusts (ACT), a non-profit organization dedicated to benefiting community health, welfare, educational and cultural activities.

**Orville E. Isenburg,** formerly general manager of the Harmon Color Works for the B. F. Goodrich Chemical Co., has been appointed managing director of the B. F. Goodrich Iran, S. A., a newly organized Goodrich subsidiary.

**Arthur W. Bruce,** comptroller for the Dominion Rubber Co., Ltd., **Lee L. Keener,** treasurer for B. F. Goodrich Canada, Ltd., and **Harold E. Anderson,** assistant comptroller for the Eagle-Picher Co., have been elected to membership in the Controllers Institute of America.

**A. J. Johnson,** vice-president of the Development and Engineering Division of the Shell Development Co. Emeryville Research Center, has celebrated his 30th anniversary with the company.

**Robert P. Wolf, Jr.,** who has been with the company since 1951, has been named manager of accounting at the Riverside, N. J., plant of the B. F. Goodrich Industrial Products Co.

## Pitt-Consol Issues Brochure

► Pitt-Consol Chemical Co., Newark, N. J., has released a new bulletin and price list which cover "Pitt-Consol 500" and "Pitt-Consol 640". The brochure includes descriptions, chemical compositions, physical properties and applications of both these materials. Pitt-Consol 500 is a high potency chemical agent for efficient reclaiming of natural rubber and synthetic rubber stocks. Pitt-Consol 640 is a high potency chemical agent for use in low concentrations to peptize natural rubber and styrene butadiene rubbers.

The company recently appointed new representatives and distributors to help market its products. Wyrough and Loser, Trenton, N. J., will cover New England and the East Coast. Tumpeer Chemical Co., Chicago, Ill., will represent the company in the Middle West, and R. D. Abbott Co., Inc., Los Angeles, Calif., has been assigned to handle sales on the West Coast, Colorado and Utah. The company will handle Ohio by direct contact out of its Pittsburgh office in the Koppers building.

## AviSun To Build Film Plant

► AviSun Corp., Philadelphia, Penna., has announced that it will build a ten million pound per year polypropylene film plant on a 214 acre site near New Castle, Penna. AviSun, an equally-owned affiliate of American Viscose Corp. and Sun Oil Co., also has announced that Nicholas E. Carr., manager of manufacturing—film and fiber for AviSun, will serve as plant manager of the new facility, which is expected to be completed in the Fall, 1959. Mr. Carr is a graduate of Massachusetts Institute of Technology. He joined American Viscose in 1940 as technical assistant to the plant manager at the Marcus Hook, Penna., rayon manufacturing plant. He later served as manufacturing superintendent of the firm's Fredericksburg, Va., cellophane plant and then assistant plant manager.

## Tire Factory for Ecuador

► The United States Embassy at Quito, Ecuador, reports that tariff protection and import privileges have been granted for the construction and operation of a tire factory in the city of Cuenca. Partially owned by General Tire & Rubber Co., Akron, Ohio, the factory is expected to begin production early in 1960, and to meet most of the Ecuadoran demand for tires. The Embassy states that after the first five years of production, the factory will be obliged to pay full duties on imports of raw rubber, a condition imposed in an effort to encourage establishment of rubber plantations in Ecuador. It is felt that the establishment of the tire industry in Ecuador may alleviate, to some extent, the effect of the decline of the Panama hat industry.

# Financial News

### Haveg Industries

► Quarter ended March 31: Net income of $130,112, which is equal to 34c per share, compared with $71,246, or 19c a share, in the same period of 1958. Sales in the first quarter of this year totaled $2,625,576, compared with $1,776,907, in the 1957 first quarter. Figures for 1958 have been adjusted to include operations of American Super-Temperature Wires, Inc., acquired July 31, 1958.

### Harshaw Chemical

► Six months ended March 31: Net income of $1,182,873, which is equal to $1.12 per share, compared with $722,103, or 81c a share, in the first six months of the preceding year. Sales in the 1959 first half totaled $33,712,772, compared with $31,706,026 in the equivalent period last year. The 1959 per share figure includes a special credit equal to 28c a share.

### McNeil Machine

► Quarter to March 31: Net income of $687,744, which is equal to $1.13 per common share, compared with $313,703, or 48c, in the same period last year. The company report stated that under the former accounting policy of accruing royalties at year-end instead of throughout the year, earnings for the 1959 period would have been equal to 76c a share.

### Goodyear

► Quarter to March 31: Estimated net income of $16,996,790, which is equal to $1.57 per share, compared with $10,857,506, or $1.00 a share, in the first quarter of 1958. Sales in the first three months of this year totaled $370,572,209, compared with $308,279,703 in the same period last year.

### Hewitt-Robins

► Quarter ended March 31: Net income of $87,581, which is equal to 18c per share of common stock, compared with $225,648, or 54c in the first three months of 1958. Sales in the 1959 first quarter totaled $10,877,128, compared with $12,707,902 in the equivalent period of the preceding year.

### Flintkote

► Quarter ended March 31: Net income of $1,515,963, which is equal to 32c per common share, compared with $471,331, or 5c a share, in the same period last year. Sales in the first quarter of 1959 totaled $42,543,791 compared with $34,996,435 in the equivalent period of 1958.

### Atlas Bucron Tire

► An all-butyl automobile tire, the Atlas Bucron, has been introduced in 18 eastern and southern states by the Esso Standard Oil Co., New York, N. Y. Said to have outstanding shock absorption qualities, the use of butyl rubber is expected to result in smoother-riding, safer, quieter automobile tires. Esso Standard states that the Atlas Bucron will stop an automobile in 1/3 less distance than conventional tires and also stops faster on wet roads than ordinary tires stop on dry roads. Its excellent traction eliminates screeching and squealing when stopping or rounding corners.

Other advantages of the all-butyl tire are its resistance to ozone, weather and chemicals and that it stands up well in use over rough roads. Tested under all conditions in all parts of the world, the tire showed an ability to resist all climates; was virtually puncture-proof; and had excellent storage life, Esso Standard states. The Atlas Bucron passenger tire is of tubeless construction with a two-groove construction made possible by the use of butyl. Butyl was invented in 1937 by the Esso Research and Engineering Co. Two years ago, the Department of the Army approved for military use, a heavy-duty, all-butyl truck tire.

### Fredericks Addresses Advertisers

► Edward J. Fredericks, vice-president of sales and marketing of Rubbermaid Inc., Wooster, Ohio, gave a talk called "Time for a Change", before the Association of National Advertisers on May 20, at the Edgewater Beach Hotel, Chicago, Ill. Mr. Fredericks stressed that every company has to have a marketing point of view. This view, he said, has to be simple enough that everyone can understand it—the employee who makes the product, the saleman who sells it, the wholesaler and retailer who handle it, and the consumer who will sense, impulsively, the worth of the product. He explained that Rubbermaid's point of view was to keep the line exciting by introducing new products into it often; products must be functional and still be excellently designed; and sometime in the life of every consumer product it is "time for a change."

### I.R.I. Elections

► The Institution of the Rubber Industry, London, England, has announced the election of Dr. Philip Schidrowitz as the first life vice-president of the Institution in recognition of his outstanding services to the Institution through the years. The Institution also announced the admission to the Associateship of K. F. Heinisch and R. H. Burton. A licentiateship (equivalent diploma) was awarded to Swedish candidates K. A. Oberg and K. O. Lindman.

# Obituaries

### *Robert E. Williams*

► Robert E. Williams, vice-president of Disogrin Industries, died on April 11, at his home in Bronxville, N. Y. He was 47 years old. A graduate of Purdue University in 1934, he received an M.A. and Ph.D degrees from Columbia University. He was a former assistant editor for the American Institute of Electrical Engineers. Mr. Williams began his business career as a marine designer for Gibbs & Cox in New York and later was with the Westinghouse Electric Corp., the Standard Oil Co. (N. J.) and the Association of Consulting Management Engineers. Prior to joining Disogrin in 1956, he had been general manager of Greer Industries. He is survived by his wife and daughter.

### *Philip G. Lovell*

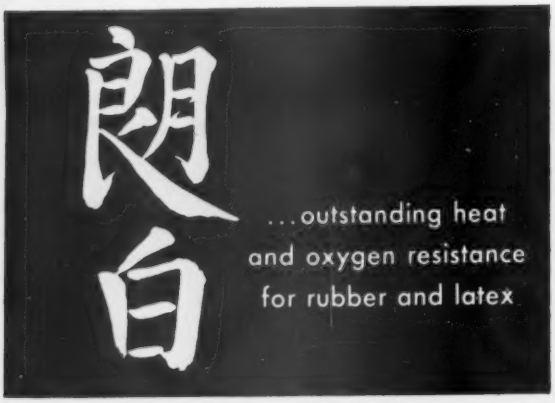
► Philip G. Lovell, retired vice-president of the Wellington Sears Co., died on June 19 at Memorial Hospital in New York City after a long illness. He was 64 years old. Mr. Lovell, who had been with the company for 30 years, had been with the company for 30 years, had been a vice-president since 1941. An Army veteran of the Mexican border campaign, World War I and World War II, he was the recipient of the Legion of Merit. Mr. Lovell was a member of the General Arbitration Council of the Textile Industry, the Textiles of the American Standards Association and the American Hotel Association. He is survived by his wife, two sons and a daughter.

### *Maurice J. Ross*

► Maurice J. Ross, export manager for the Henry Disston and the Quaker Rubber Divisions of H. K. Porter Co., Pittsburgh, Penna., died recently of pneumonia at the Einstein Medical Center in Philadelphia, Penna. Prior to his association with Porter, Mr. Ross was in the Export Department of the Firestone Tire and Rubber Co., Akron, Ohio. He was a native of Brookline, Mass., attended Boston University and served as an infantry captain in World War II. Surviving are his wife, two daughters and a son.

### *Arthur Wolf*

► Arthur Wolf, a U. S. Government rubber authority, died recently in George Washington University Hospital, Washington, D.C. He was 49 years old. Mr. Wolf had been in Government service since 1936, and was director of Rubber, Agricultural and Forest Production Operations of the Office Civil Defense and Mobilization.

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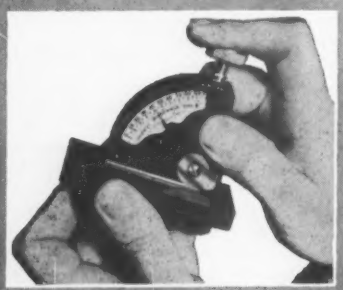

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## New Goods

### Flexiprene Industrial Glove

► Neoprene-coated industrial gloves said to be so flexible that you can pick up a pin while wearing them, have been developed by Hood Rubber Products, Watertown, Mass., a division of the B. F. Goodrich Co. According to the company, the flexibility and comfort of the new gloves are greater than that of other oil-resistant industrial

gloves. This is attributed to the utilization of a special process in which a knitted jersey shell, or glove-like liner, is coated with neoprene.

The new gloves, called Flexiprene, reduce hand fatigue because they require less effort to bend the fingers than do other neoprene-coated gloves and also provide additional safety features. This flexibility reduces clumsiness and the knitted construction makes it possible to have the seams on the sides of the fingers, where they are less likely to chafe or split. Flexiprene gloves are available in three lengths: the wrister, with a green knit wrist; a 12-inch gauntlet; and a 14½ inch gauntlet.

### Goodyear Rubber Fender

► Goodyear Tire & Rubber Co., Akron, Ohio, has introduced a new rubber fender for trucks, truck docks, small marine vessels and industrial applications. Called the M-4, the new fender is designed to absorb shock loads created by docking trucks or vessels and is produced in a new shape that prevents vehicle or vessel snagging. The fender has a flat base, tapered sides and a rounded front. The M-4 can be installed horizontally, vertically or diagonally and when mounted, protects all hardware, the company states. Goodyear's new rubber fender can be supplied in lengths up to 19 feet for installation on wood, concrete or steel. The fender base is 4½ inches and height is 3¾ inches.

# Air Pressure Alone Holds Up World's Largest Fabric Dome!

*the problem:* **To provide a large missile shelter of economical construction, easily transported and quickly erected.**

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Birdair Structures, Inc. specified that the 18,000 square yards of nylon base fabric for vinyl coating be by Wellington Sears. Designed to retain flexibility at −40° F., it is the heaviest single-ply fabric ever used in an air-supported structure.

Wellington Sears, with over a century of experience, would welcome the opportunity to help you solve problems related to fabrics, in rubberizing, coating, laminating, or any combination of textiles with other materials. For a useful booklet, "Fabrics Plus," write Dept. G-7.

Preparing to put up Pentadome, made by Birdair Structures, Inc., Buffalo, New York. Wellington Sears nylon base fabric was vinyl-coated by Sawyer-Tower, Incorporated, Watertown, Mass.

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Albertville, (Ala.), Greenville, (S. C.)



## Conveyor Belting

► A patented flange edge conveyor belting which eliminates the use of troughing idlers is available from MonoBelt Corp., 1980 Mountain Blvd., Oakland, Calif. The new one-piece belting, called "Monobelt", is said to be pre-tensioned to flex as it passes around the pulleys, eliminating fatigue due to flexing and allowing belt speeds much

higher than those possible with troughed flat belts. With an increased cross-section area, higher angles of incline are possible because Monobelt traps material on three sides. The belt is available in widths up to 48 inches. It comes in every grade, type and class of belting including oil, heat and flame resistant types, canners belting, super canners oil resistant belting, and various grades for handling moderate to extremely abrasive materials, the company reports. Special purpose Monobelt is available in any width from 8 to 48 inches wide. Flange sizes range from 1 to 3 inches.

## Manhattan Slasher Roll

► Manhattan Rubber Division of Raybestos-Manhattan, Inc., Passaic, N. J., has developed a new synthetic rubber covered sizing roll which is said to permit faster and easier detection of yarn end breaks. This roll, now in production at Manhattan roll plants in North Charleston, S. C., Passaic, N. J., and Neenah, Wisc., is covered with a distinctive bright red synthetic rubber compound which has been developed especially to control the pick up of size from the reservoirs and is said to have completely uniform roll finish and density. The new roll also has a cushioning effect without indentation, which is said to eliminate downtime to maintain the blanket. Roll end-caps prevent metal corrosion between cover and metal core while the roll can be re-ground to yield still longer service life. According to Manhattan, the covering of the new red slasher roll has a very high resistance to starches, gums, softeners, oils, chemicals and synthetic finishes.

R. A. B. R. M.

# Technical Manuals

## Conductive Rubber: Its Production, Application and Test Methods

by R. H. Norman

**(RABRM Manual No. 1).**

The first of several technical manuals produced by staff members of the Research Association of British Rubber Manufacturers, this publication surveys a whole mass of results and presents the main conclusions in a form which can be readily used by the industry. The manual deals extensively with the conductive and antistatic classes of rubber. The effects of stress, time and other variables on resistivity are covered as are test methods and the uses of conductive rubber. A complete index is provided. 99 pages.

**$3.50**

## Ebonite: Its Nature, Properties and Compounding

by J. R. Scott

**(RABRM Manual No. 2)**

A mine of basic information which will enable the manufacturer of hard rubber (ebonite) to provide products that will give the best possible service. It gives the results of investigations into the dependence of mechanical, electrical and other properties on composition, vulcanization, etc. It covers such subjects as improving the resistance to "plastic yield" and reducing surface deterioration in light. Resistance to swelling action of organic liquids and solvents is also discussed. 294 pages.

**$8.00**

## Analysis of Rubber and Rubber-Like Polymers

by W. C. Wake

**(RABRM Manual No. 3)**

The first modern work devoted solely to this important subject to be published in the English language. In addition to an analysis of natural and synthetic rubbers, the author deals with polyethylene, PVC, PVDC, PVA and the polyurethanes. Also discussed are the identification of compounding ingredients used in these polymers. This thorough and useful work will unquestionably become a standard and is a must for all interested in the analysis of rubber and rubber-like polymers. 250 pages.

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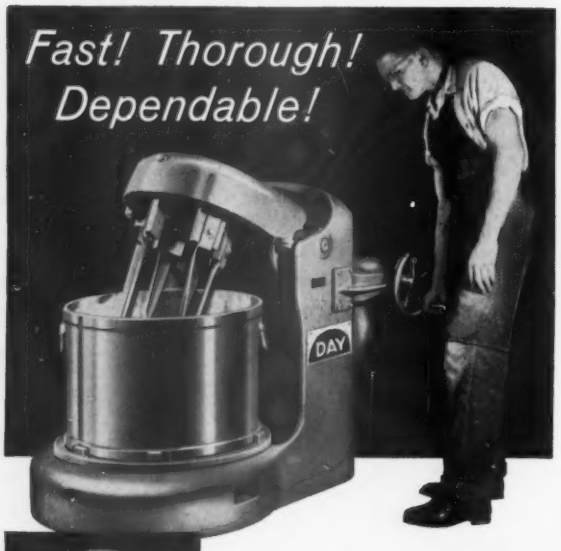


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## Orthopedic Shoe

► An orthopedic shoe that will not only mold to the foot but can bend and bow when weight is borne on flat solid surfaces, has been invented by Dr. Howard M. Goldberg, podiatrist, 1384 Grand Concourse, Bronx, N. Y. According to Dr. Goldberg, it is this bending and bowing action in weight bearing on flat solid surfaces that will prevent and cure foot damage. In the construction of the orthopedic shoe, a simple flat rubber pad is added to the outer sole of an all planed (flat) surfaced shoe.

The shoe to which the pad is added is a non-shanked shoe. Some typical constructions that can be made are: (1) an inner sole of leather and an outer sole of rubber; (2) an inside of foam rubber or a mixture of foam rubber and cork, a platform or midsole of paper board and an outer sole of leather, rubber or composition; (3) an inner lining of foam rubber, a platform of soft wood and an outer sole of rubber; and (4) many combinations or variations of the above. The upper of the shoe can be of any material and design, even a sandal, as long as the shoe is held to the foot.

## Naugaweave Upholstery

► U.S. Rubber Co., 1230 Avenue of the Americas, New York, N. Y., has introduced a new line of Naugaweave for furniture upholstery called Advance, which is said to have the breathability, soft look and feel of fabric and the durability and cleanability of vinyl. Advance is made by a new manufacturing process that combines vinyl and fabric, with valley printing and embossing on a discontinuous pattern. Metallic flitters are used for subtle highlighting. The printing of blended colors deep into the textured surface valleys gives a three-dimensional look to the upholstery, the company states. It is being introduced in ten colors: blue, mocha, gold, cardinal, spice brown, turquoise, grass green, charcoal, tangerine and antique white. It is 54 inches wide and is being marketed in 30-yard rolls.

## Martin 14-B Spray

► Martin Rubber Co., Long Branch, N. J., has introduced a new spray to its housewares line. Designated "No. 14-B Spray", the new product is a shower type spray which contains the usual "fits-all" faucet connection. There are 5½ feet of tubing and a massage brush head, which is attached with a ball joint to a large suction cup, enabling the unit to be attached securely to a wall. A patented quick-release knob enables the user to break the suction at once without difficulty. The product is available in pastel colors.

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## Protect-O-Therm Bottle Holder

► Worcest Moulded Plastics Co., Worcester, Mass., has introduced the Protect-O-Therm bottle holder, a heat-retaining, feather-light container

designed to keep babies' milk warm. The container, which is molded of Dylite expandable polystyrene, comes in blue and is sold in combination with an eight ounce pink or blue nursing bottle by the Reliance Manufacturing Co., Woonsocket, R. I. It will accommodate any size nursing bottle.

## Krene Vinyl Suit

► Plastimayd Products Corp., Portland, Ore., has developed a safety garment, made of Bakelite Krene vinyl sheeting, which is reported to have a high dielectric strength exceeding the requirements of the Flammable Fabrics Act. According to the company, the garment, consisting of jacket and pants, offers resistance to acids, oils, alkalis, and will not mildew when wet. The outfit is made of 20 gauge, olive-drab Krene sheeting and is reported to have strong welting reinforcement incorporated at the bottom of the jacket sleeves and legs for added strength.

## Barr Tanker Pumper Truck

► Barr Rubber Products Co., Sandusky, Ohio, has introduced a new Tanker Pumper Truck, into its toy line, that really pumps water. Manufactured in gay colors and made of flexible, unbreakable polyethylene, the Tanker Pumper Truck is said to be a perfect replica of a full-sized model. It is 21 inches long, 5 inches high and is packaged in a see-through displayer. Barr also makes the Mira-Toy truck line which includes a van and road tractor, stake trailer and road tractor, and farm tractor and wagon.

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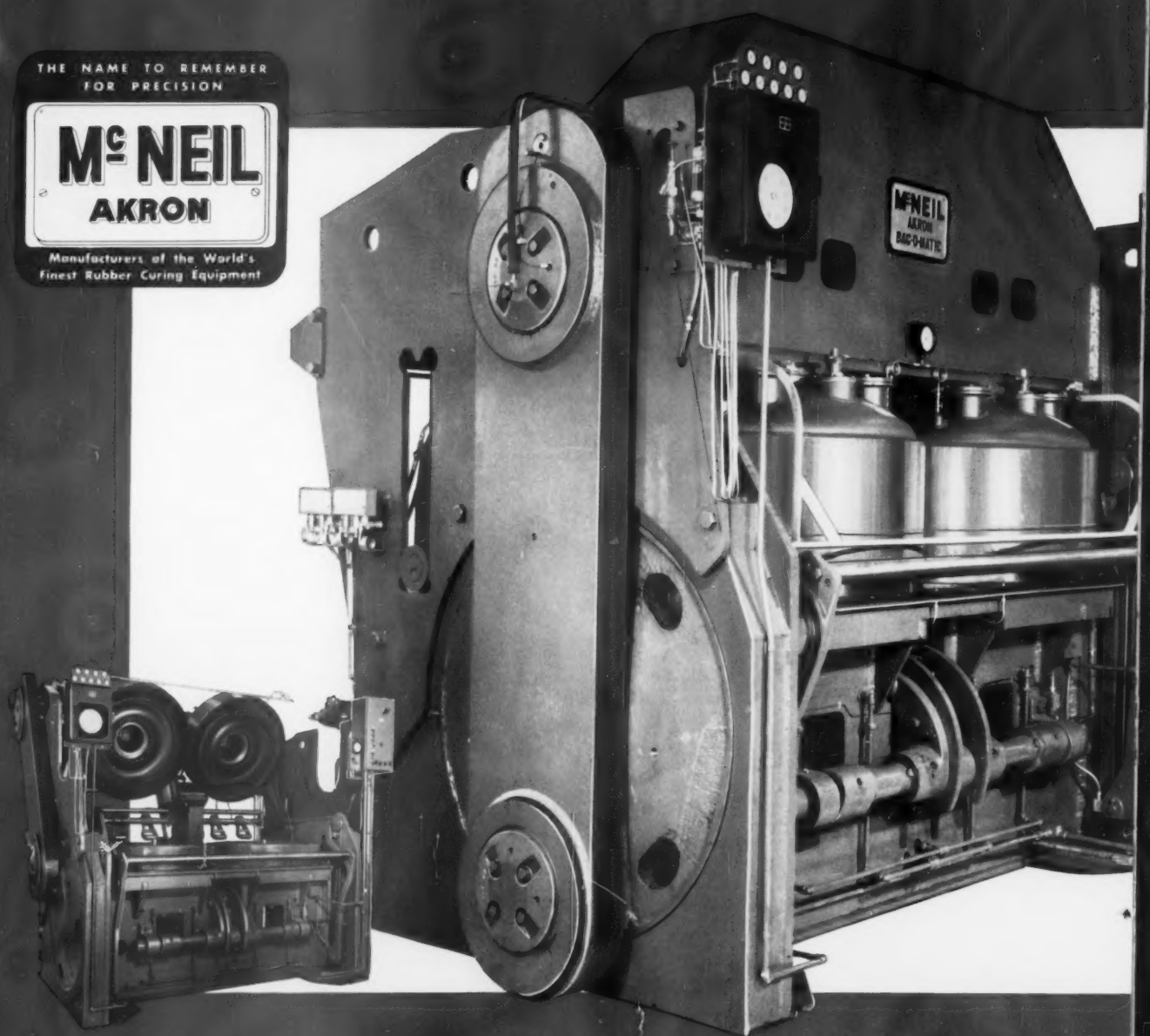

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★ Press has holding force of 825,000 pounds on each mold position, almost twice the pressure of previous Bag-O-matic presses.

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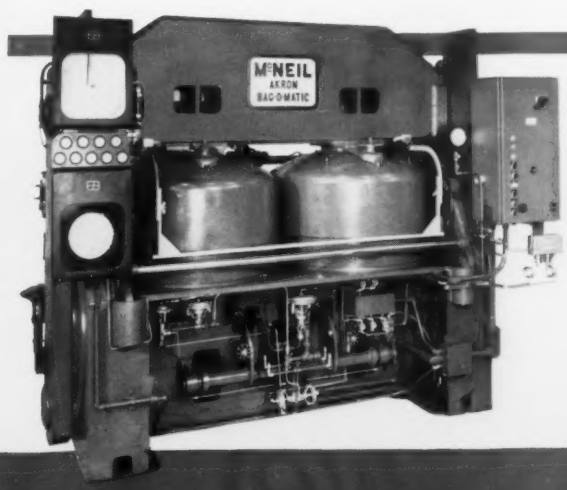


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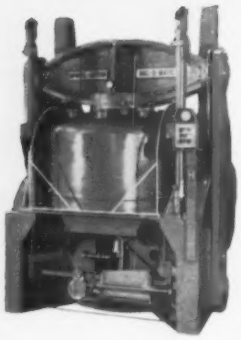

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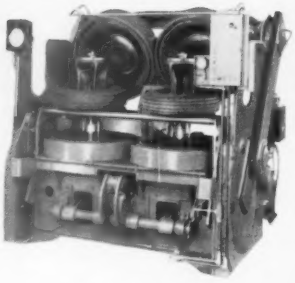
BAG-O-MATIC Tilt-Back



Model 450-55-14D-M-4
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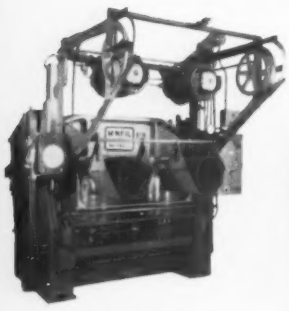
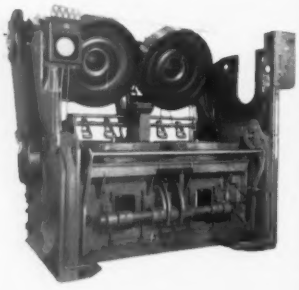
Also available with automatic features

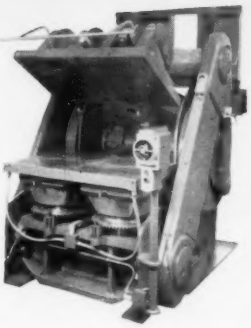


Model 230-40-11½
Twin BAG-O-MATIC
with automatic — loading-unloading and post-cure inflation



Model 825-55-14D-M-5
BAG-O-MATIC

## MECHANICAL GOODS PRESSES



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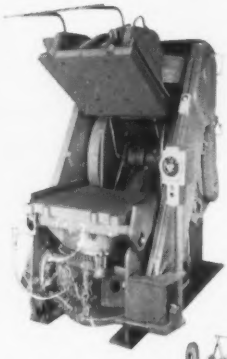

Model 800-32
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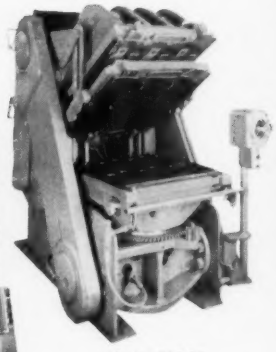
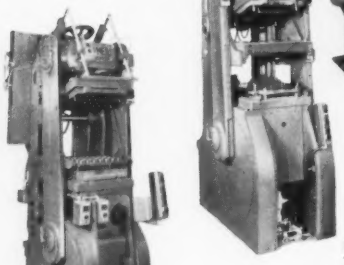


Model 800-32
Intermediate Platen



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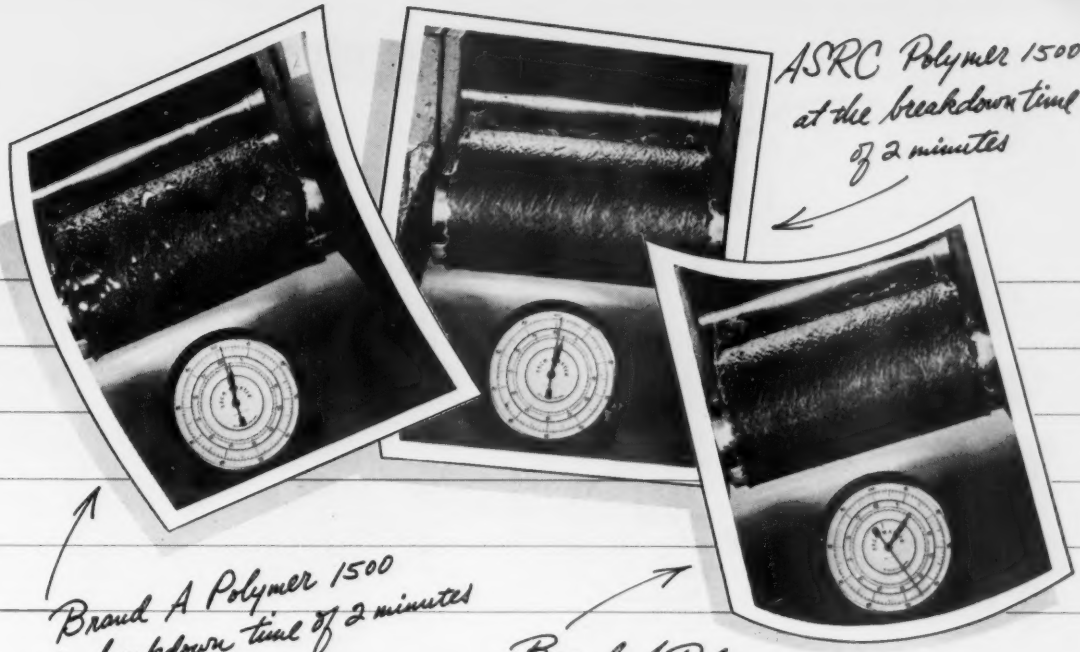
ASRC Polymer 1500 at the breakdown time of 2 minutes
Brand A Polymer 1500 at the breakdown time of 2 minutes
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Report on Polymers

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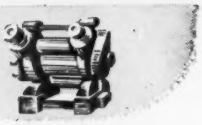
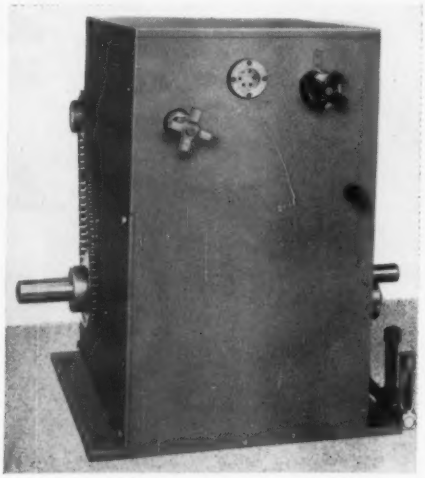
## New Equipment



### Temco Winder Drive

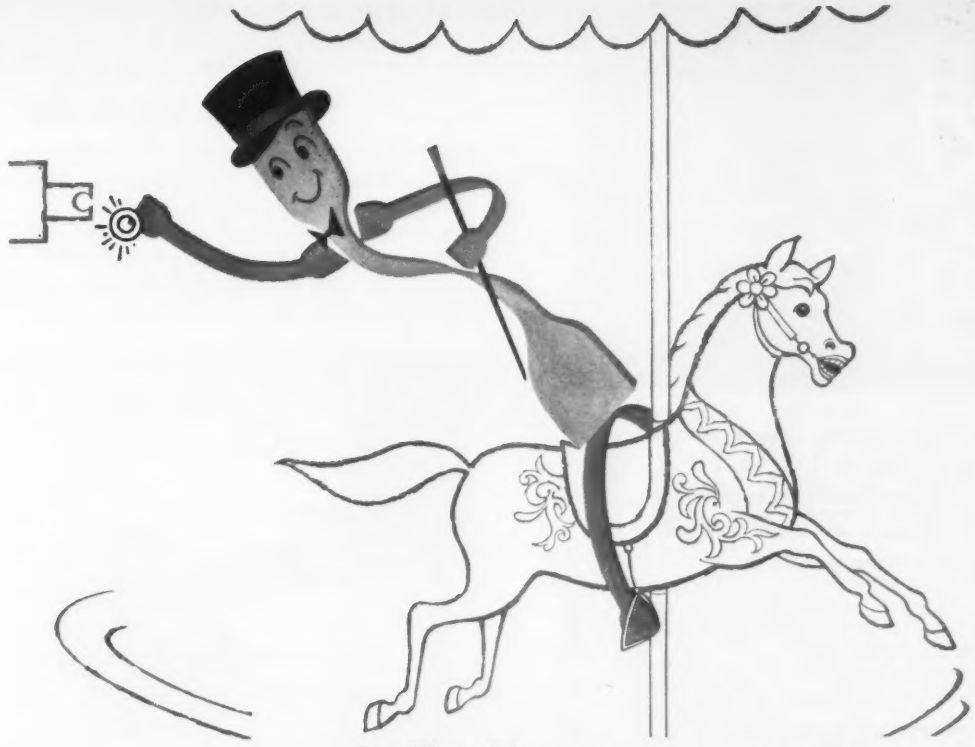
► A recently redesigned model of the Temco constant tension winder drive, manufactured by Sealol Winders, Inc., 23 Post Road, Providence, R. I., incorporates a number of new features. Completely enclosed in cast iron tanks, to make



leakproof units, the drives are designed for use either with an existing windup stand or in conjunction with the complete Temco winder unit. A single unit will wind many types, widths and thicknesses of materials at various constant tensions, linear speeds and roll build-ups. Specifications are: tension range, zero to maximum capacity of the unit; linear speed range, to 6,000 fpm; roll build-up range, 100 to 1, and hp range, 1½ to 100 hp. The manufacturer recommends the unit for use with rubber, metal, wire, plastic and other materials.

### Portable Electrical Calibration Standard

► The Taylortest I, a new portable instrument for checking, installing or servicing Taylor potentiometer transmitter and allied equipment, is manufactured by Taylor Instrument Companies, 95 Ames St., Rochester 1, N. Y. The device is a combined precision signal source, full potentiometer and milliammeter. It is also useful for calibrating all forms of amplifiers or servomechanisms which converts small signal voltages (millivolts) into proportional electrical currents (milliamperes) for control or transmission use. The self-contained instrument is said to provide all facilities, accuracy and convenience requisite to testing in both the field and laboratory. Its dimensions are $5\frac{5}{8}$ x 8 x $5\frac{9}{16}$ inches, and its weight is 5½ pounds.



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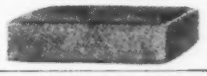
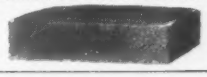
**CURRENT PHILPRENE POLYMERS**

| | NON-PIGMENTED  | PIGMENTED WITH PHILBLACK*  |
|---|---|---|
| HOT | PHILPRENE 1000 PHILPRENE 1009<br>PHILPRENE 1001 PHILPRENE 1018<br>PHILPRENE 1006 PHILPRENE 1019 | |
| COLD | PHILPRENE 1500<br>PHILPRENE 1502<br>PHILPRENE 1503 | PHILPRENE 1601<br>PHILPRENE 1603**<br>PHILPRENE 1605<br>**Pigmented with EPC Black |
| COLD OIL | PHILPRENE 1703<br>PHILPRENE 1708<br>PHILPRENE 1712 | PHILPRENE 1803 PHILPRENE 6608<br>PHILPRENE 1805 PHILPRENE 6620<br>PHILPRENE 6604 PHILPRENE 6661***<br>PHILPRENE 6682***<br>*** Carbon black slurry made by Philjet® Process |

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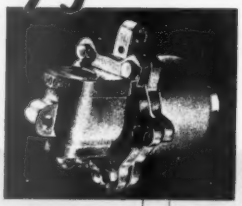

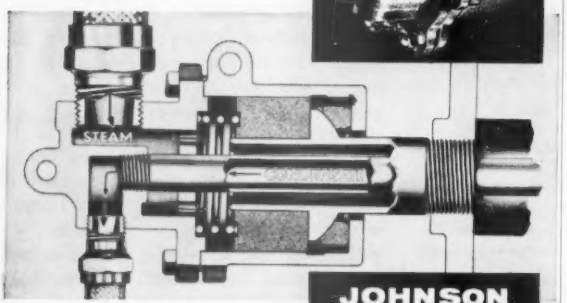


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868 Wood St., Three Rivers, Michigan




## Goodman Inspection Table

► A new model of the vibratory feed inspection table manufactured by G. F. Goodman & Son, 401 Richmond St., Philadelphia 25, Penna., features a luminous panel under a translucent conveyor belt. Designed to facilitate the inspection procedure, the table features a translucent polyethylene belt which is .60-inch thick and 15

inches wide. The luminous panel which supplies the illumination is a removable fixture with four 20-watt fluorescent tubes. The table top has a height of 31 inches and width of 24 inches. Working length is 36 inches. Legroom is 25 x 44 inches, and the floor space occupied by the table is 6 x 2 feet. The belt speed is variable from 10 to 20 feet per minute. Belt speeds above or below this range, with a 2:1 speed variation, can be furnished to customer's specifications at no extra charge. The vibratory feeder has a capacity of up to 800 pounds of rubber moldings per hour. The table is powered by a 1/3 hp ball bearing motor, variable speed unit, speed reducer and roller chain. Weight of the unit is 410 pounds, shipping weight 500 pounds.

## Shrinkage and Draft Calculator

► A new compact shrinkage and draft calculator has been announced by Kelm Manufacturing Co., Coloma, Mich. The calculator, a plastic slide-chart type, is said to be invaluable for draftsmen; students; tool, die and mold makers, and inspectors in the rubber and other industries, in providing a time-saving and error-reducing method of determining shrinkage and draft values. It also includes charts of tap drill sizes, decimal tables, and other frequently used data. The calculator comes in a convenient pocket size and is printed on plastic.

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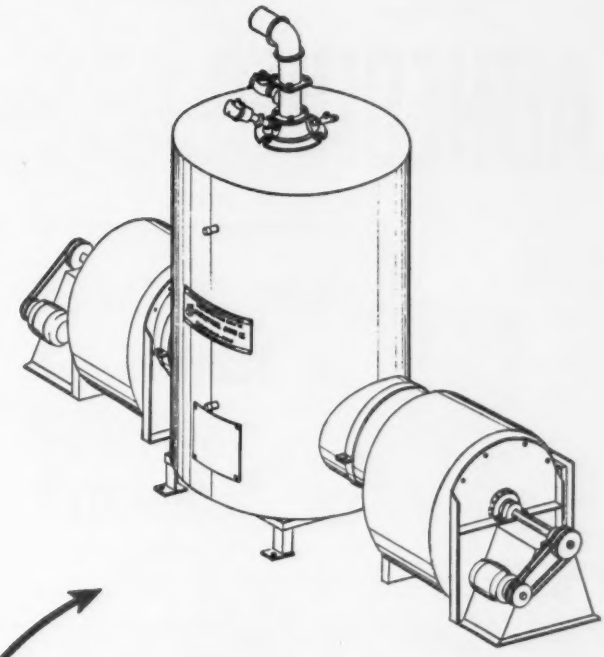

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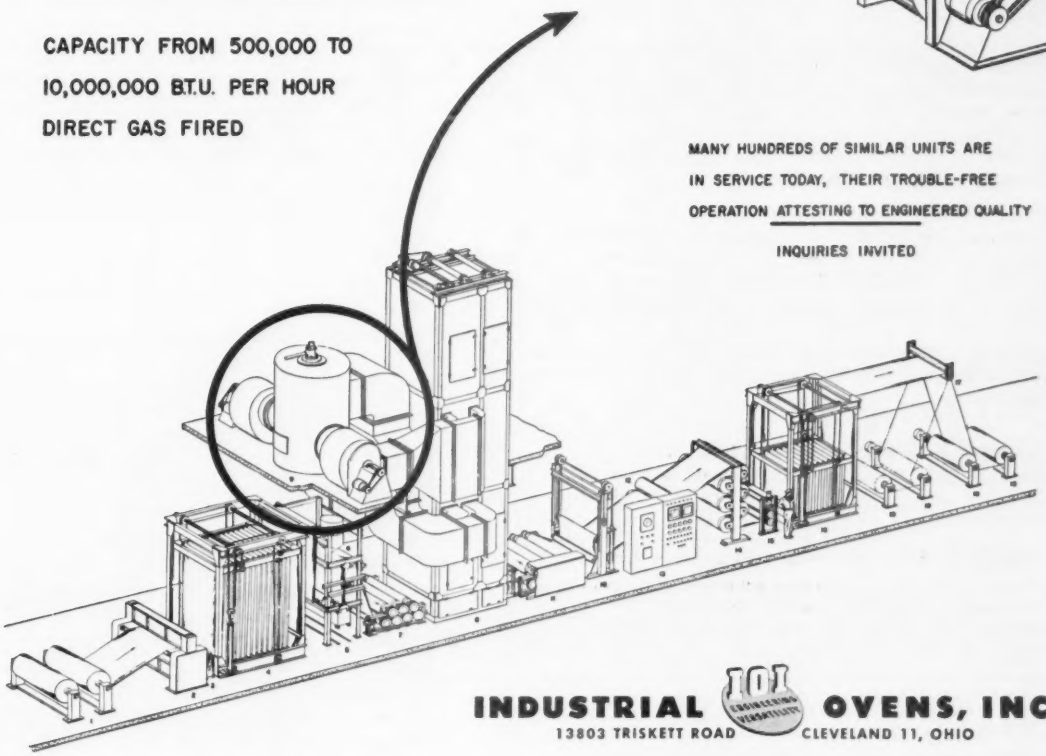

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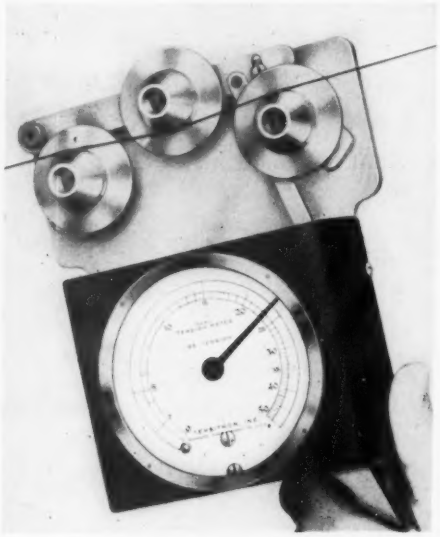
## Tensitron Tension Meter

► A new instrument with a range as high as 50 pounds checks tension on moving wires and other filamentous or flat materials. A sensing roller is lifted elastically in proportion to the strain exerted



on it. This motion, amplified over a shockless spiral movement, is indicated on a dial with good legibility. The gage mechanism is designed to average the readings for steady observation of the average tension. Precision ball bearings are said to permit use of the instrument even when wires are traveling at thousands of feet per minute. Manufacturer of the instrument is Tensitron, Inc., Harvard, Mass.

## Nuclear Thickness Gage

► A nuclear thickness gage, designated Model 42000, is designed to measure: (1) Material thickness to two-millionths of an inch without contacting the material; (2) Thickness of protective coverings, coatings and impregnations to within 0.01% of total material thickness; and (3) Changes in basis unit weight of .005 mg./sq. cm. The gage is recommended for measuring rubber, and has application in continuous process industries where quality control is important. The material to be measured flows past a small radioactive source. The gage measures the amount of radiation which passes through the material. Changes in material thickness cause changes in the strength of radiation detected. This change is indicated in units of thickness or in weight per unit area. The instrument is manufactured by Radiation Counter Laboratories, Inc., Nucleonic Park, Skokie, Ill.

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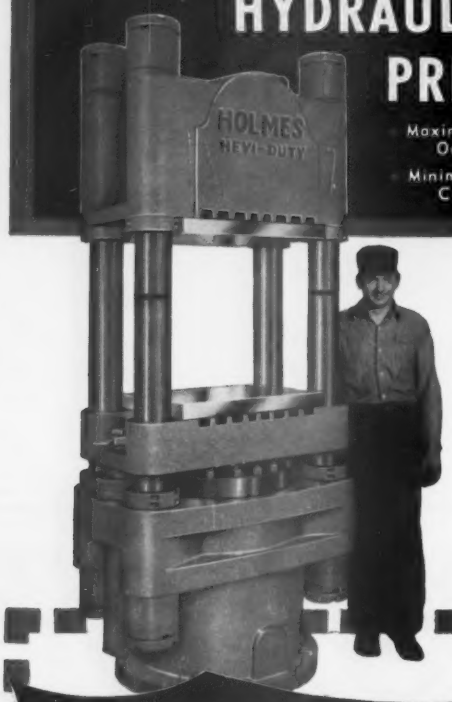


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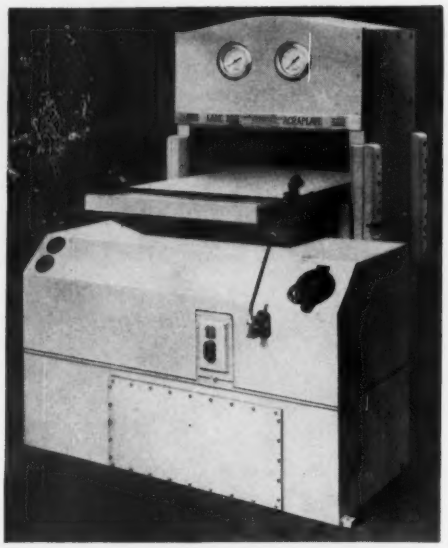
## Molding and Laminating Presses

► A line of self-contained hydraulic presses for molding or laminating, known as Lake Erie Acraplates, is designed and manufactured by Lake Erie Machinery Corp., P. O. Box 68, Buffalo, N. Y. Ideally suited for laboratory work or specialized production, the presses come in three



standard sizes. Heavy side plate construction and large rams underlying nearly the entire platen areas are said to provide platen parallelism within .003-inch over the full area. A hardened and ground rolling work plate facilitates otherwise difficult work loading. The presses are offered in seven tonnage capacities of from 180 to 400 tons with platens from 24 x 20 inches to 36 x 28 inches. All models are provided with either hand lever or automatic pushbutton operating controls. Time cycle controls are also available, as is a pressing speed control. Seven inch daylight and stroke are standard but subject to optional variation. Either electrically heated or steam heated platens are available, though they can be substituted by plain wear plates.

► A new **production line marker** is designed to print trademarks, designs, patent numbers, instructions or other markings on many materials, including rubber. Manufactured by General Research & Supply Co., 572 S. Division Ave., Grand Rapids, Mich., the marker is claimed to print clearly and cleanly at production line speeds.

► The Abbeon **humidity indicator,** a product of Abbeon Supply Co., 179-40K Jamaica Ave., Jamaica, N. Y., shows relative humidity at a glance with no calculations. Six inches in diameter, the unit has an upper temperature range limit of 230°F.

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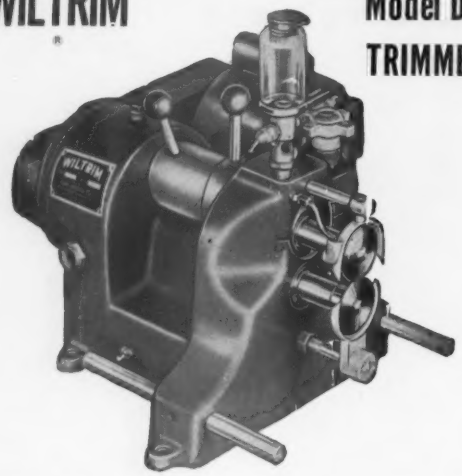

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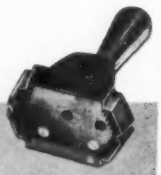

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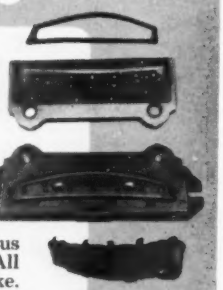

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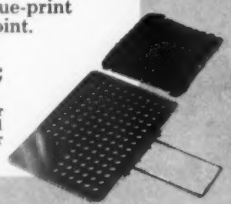

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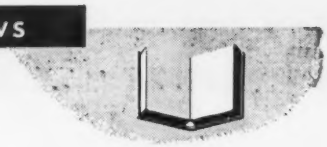
## Reviews



**Methoden der Organischen Chemie 'Houben-Weyl' (Methods of Organic Chemistry).** (Fourth Edition). Edited by Eugene Müller in coperation with O. Bayer, H. Meerwein and K. Ziegler. Published by Georg Thieme, Stuttgart, Germany. 20 volumes; average price $25.00 per volume; 7½ x 10½ in. (In German). (EDITOR'S NOTE: An over-all review of 'Houben-Weyl' appeared in the March, 1957 issue of RUBBER AGE. Reviews of Volume II, III Part 1, and VIII appeared in April, 1957; of Volumes III Part 2, IV Part 2, VII Part 1, and IX in May, 1957; of Volume XI Part 1 in January, 1958; and of Volume I Part 1 in September, 1958. Below is the review of the latest volume in the set. Additional reviews will appear in these columns as the volumes appear in print.)

**Volume XI, Part 2. 'Stickstoffverbindungen II und III.** By H. Bestian (Farbwerke Hoechst, Höchst), L. Birkhofer (Universität Köln), A. Dorlars, H. Freytag, F. Möller, G. Pieper, and H. Söll (Farbenfabriken Bayer AG., Leverkusen), J. Nentwig and H. Schnell (Farbenfabriken Bayer AG., Uerdingen), J. Goerdeler (Universität Bonn), E. Niemann, R. Müller, and Th. Wieland (Universität Frankfurt a.M.), A. Schöberl and A. Wagner (Tierärztlichen Hochschule Hanover). 840 pp. $36.30.

Volume XI, Part 1, presented general methods for synthesis of amines. The present volume covers the following subjects: Conversion of primary and secondary amines, conversion of tertiary amines, elimination of the amino group; 1, 2- and 1, 3- alkenimines, amino acids and their derivatives, lactames, quarternary ammonium compounds, and nitrogen-sulfur compounds. An author index of 50 pages and a subject index of 38 pages conclude the volume.

This volume is again up to the high standards set by the editors of the new 'Houben-Weyl'. The subject matter is fully covered and well presented and documented. A valuable feature of this volume is the inclusion of extensive tables listing pertinent preparative methods and reactions described in other volumes of Houben-Weyl and other references. The tables give the structural formulas of the compounds, yields obtained, and the literature references.

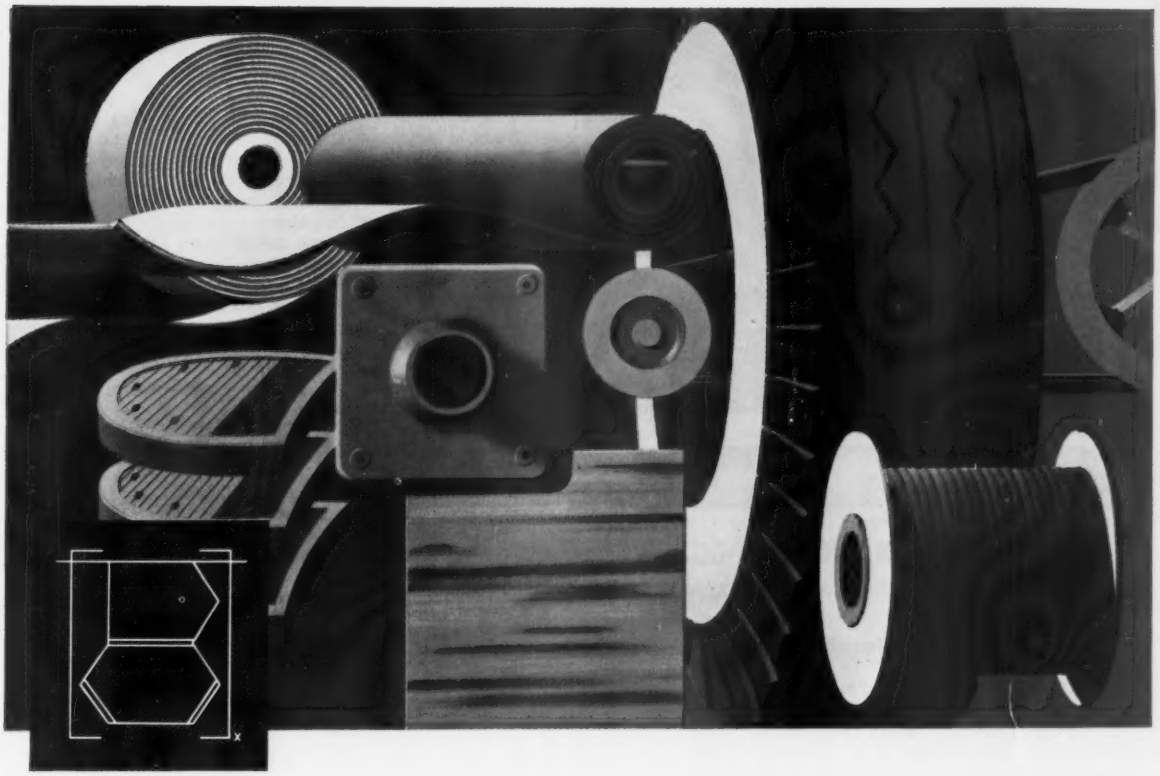
As with Volume XI, Part 1, (reviewed January, 1958), organic chemists working in the rubber field, particularly in the area of accelerators, will find this encyclopedic volume a helpful reference work.

(Enclosed with this volume are four pages of corrections of printer's errors in Volumes XI/1 and XI/2. Owners of the volumes will do well to affix the pages to the books and to make the corrections in the text since some of the errors are rather disturbing.) F. R.

•

**Polymers and Resins: Their Chemistry and Chemical Engineering.** By Brage Golding. Published by D. Van Nostrand Co., Inc., 120 Alexander St., Princeton, N. J. 6 x 9½ in. 744 pp. $15.00.

The author of this book, after searching for an up-to-date text which presented theory, chemistry, properties, manufacture, fabrication and applications of polymeric and resinous materials and being unable to find it, decided to write one. The end product, he says, is twice the size originally intended because of the large amount of material to be covered in each of these fields, despite the fact that only products of commercial significance



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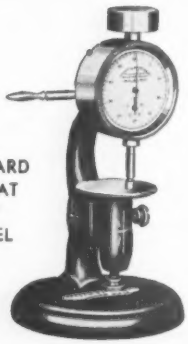

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were included for discussion. Though he may be surprised at the size of this thick volume, he can take comfort in the knowledge that he has not permitted quality to suffer for quantity. He has produced a valuable, well-written and highly technical text for the advanced and graduate student of the chemistry and chemical engineering of organic, polymeric and resinous substances, and a book which will serve for some time as a reference to these rapidly expanding fields.

A listing of the chapter titles indicates the broad scope of the treatment: (1) Introductory Concepts and Definitions; (2) Functionality and Polymer Formation; (3) Mechanical and Chemical Behavior; (4) Characterization of Polymers; (5) Methods of Polymerization; (6) Technology of Manufacture: Natural Products; (7) Technology of Manufacture: Modified Natural Products.

And (8) Technology of Manufacture: Synthetic Condensation Products; (9) Technology of Manufacture: Synthetic Addition Products; (10) Effect of Molecular Structure upon Mechanical Behavior; (11) Fabricating and Processing, and (12) Applications. Subject and name indexes close the volume. A list of literature references follows each chapter.

The different kinds of rubber and flexible foams, of course, are referred to throughout the text. In fact, there is hardly a chapter which omits reference to the products of our industry. In addition, the chapter on "Applications" carries a section specifically devoted to elastomers. It contains information on the industrial uses of various rubbers, and of current developments in commercial applications.

The other references to elastomers made throughout the book are easily locatable in the subject index. The author has produced an excellent and timely volume with extensive coverage of the incredibly complex, expanding and important fields of polymers and resins. The information included will benefit not only the student, but the practicing engineer and chemist.

•

**The European Common Market.** Published by American Management Association, 1515 Broadway, New York 36, N. Y. 6¼ x 9½ in. 256 pp. $4.00 (members); $6.00 (non-members).

On March 25, 1957, representatives of six Central European nations—Belgium, France, West Germany, Italy, Luxembourg and the Netherlands—met in Rome to sign treaties creating a European Economic Community and a European Atomic Energy Community. This volume examines the implications of the former, and deals particularly with those of import for American business. It shows how the European Common Market was conceived and planned, what trends and attitudes in the ECM countries may influence the American manufacturer, and how ECM will affect many aspects of U. S. business itself, especially its marketing and manufacturing policies.

The American businessman is adjusting to the realization that the proposals and terms of the Community must be given major consideration in long-range plans for foreign trade in Europe. This volume will supply much material of a background nature which will aid in an intelligent formation of pertinent policies. The plans of specific companies in relation to ECM are discussed fully, providing a valuable insight into how certain leaders in American industry are reacting to this new factor in European trade. In addition, valuable information is presented in chapters on financing and on world trade as related to ECM.

The basis of the book is a conference held by the American Management Association. The conference and the resulting volume have already done much to alert the American industry to the fact that the European Common Market is on its way to full maturity—and indeed offers new challenges and advantages in European trade.

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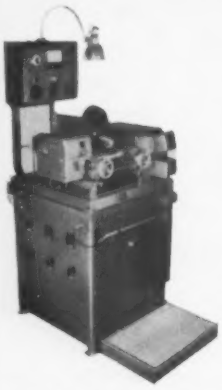

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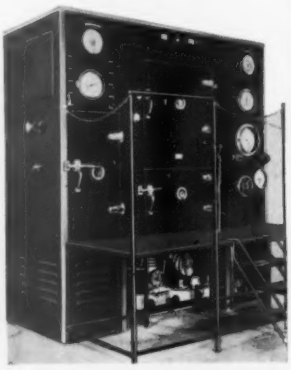

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## BOOKLETS, CATALOGS, etc.

**Multrathane Urethane Elastomer Potting Compounds.** Mobay Chemical Co., Pittsburgh 34, Penna. 8½ x 11 in. 8 pp.

This bulletin presents a technical description of the preparation of urethane elastomers for industrial potting and encapsulating applications. Two systems are available for production of suitable low durometer elastomers: a polyester-diisocyanate combination and a polyether-diisocyanate prepolymer. A typical method of urethane elastomer preparation and characteristics of the elastomers of both systems are described in the bulletin. Data on physical properties are supplied in both tabular and graph form.

•

**Disogrin.** Disogrin Industries, Inc., 510 South Fulton Ave., Mount Vernon, N. Y. 11 x 8½ in. 24 pp.

A polyurethane elastomer, tradenamed Disogrin, is discussed in detail in this brochure. Heavily illustrated with charts, graphs and photographs, the booklet describes the physical, chemical, electrical, thermal and other properties of the elastomer. A comparison of properties with those of other materials is made, and a list of the most commonly used grades, ranging from soft to hard, is included. How to obtain better design with the elastomer is also discussed in detail.

•

**Seven Plasticizers for Nontoxic Applications.** Monsanto Chemical Co., 800 North Lindbergh, St. Louis 66, Missouri. 8½ x 11 in. 12 pp.

Properties and specifications of seven plasticizers recommended for nontoxic applications are described in this booklet. Tables give comparative performance data for each in terms of volatility, solvent and water resistance, low temperature flexibility, cost and compatability with various plastic materials, including nitrile rubber. This publication is of special interest for the rubber goods manufacturer whose products come in contact with food or are used on the body.

•

**Spot Tests for Differentiating Polyester from Polyether Based Urethane Polymers.** (Technical Information Bulletin No. 13-F5). Mobay Chemical Co., Pittsburgh 34, Penna. 8½ x 11 in. 3 pp.

This unbound technical bulletin describes in detail a color test developed in response to the need for a quick method of differentiating polyether from polyester based urethane polymers. It is applicable to flexible and rigid foams, elastomers, coatings and prepolymers. The reagents used in the test and complete test procedure are described in detail. A list of precautions relating to color interpretation is included.

•

**Flow-Master Pumps.** (Catalog 25-C). Marco Development Co., Inc., P. O. Box 325, Wilmington, Del. 8½ x 11 in. 8 pp.

A line of rotary pressure pumps for transferring and metering operations is described in this fully illustrated catalog. A chart shows approximate motor horsepower requirements for various pressures and capacities, and each of the motors has a photograph, schematic diagram, cut-away sectional view and theoretical displacement chart included in its presentation. One of these, Model AC, is especially recommended by the manufacturer for metering latex.

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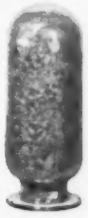

Type: Thermoplastic Hydrocarbon
Form: Flaked
Softening point (ball and ring): 210°—220°F.
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Color (Gardner): 10-11
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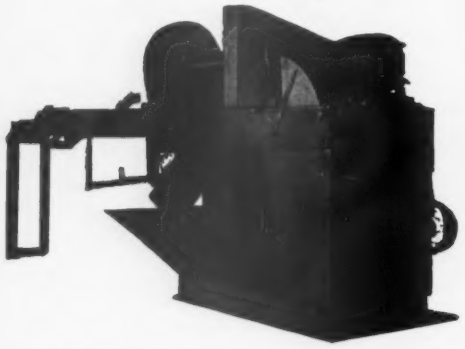

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**Ameripol Micro-Black.** Goodrich-Gulf Chemicals, Inc., 3121 Euclid Ave., Cleveland 15, Ohio. 8½ x 11 in. 16 pp.

This booklet presents detailed technical information on seven Ameripol micro-black masterbatches. It opens with a short discussion of the reasons for adding carbon black to rubber as a reinforcing agent, and the advantages of adding it to the masterbatch at the copolymer plant. Comparative microphotographs of a standard black masterbatch and the Ameripol masterbatch are shown, and production advantages and end-product advantages of the Ameripol masterbatch are listed. A one-page description of each of the masterbatches available, with a listing of chemical and physical properties and test recipes, is also presented. A well designed and interesting booklet.

•

**A Catalog and Register of Testing Machines for All Industries.** Testing Machines, Inc., 72 Jericho Turnpike, Mineola, L. I., New York. 8½ x 11 in. 244 pp.

This attractive volume provides information on 87 different categories of physical testing instruments, frequently with 30 or more different machines presented in each category. The equipment has been compiled from sources all over the world, including units produced by the publisher as well as many other prominent instrument and testing machine manufacturers. A photographic illustration and extensive information (specifications and related data) are given for each of the machines. Needless to say, in such categories as compression set and tensile strength, to mention only two, there is much information of interest to the rubber technician. Distribution is being made on a limited basis to technical and purchasing executives.

•

**OREC.** Ozone Research and Equipment Corp., 3840 N. 40th Ave., Phoenix, Arizona. 8½ x 11 in. 10 pp.

This bulletin presents information on the products of a company devoted exclusively to research and development in ozone technology and the manufacture of ozone instrumentation and equipment for science and industry. The booklet opens with general information on the OREC 0300 series automatically controlled ozone chambers, giving data on the control system, range modifications and general specifications. Various models are then examined individually, with a description of their particular specifications. The latter part of the booklet deals with the OREC M series of manually controlled chambers. Accessories to go with the chambers and company services are also discussed.

•

**Stewart Bolling Spiral-Flow Intensive Mixers for Rubber and Plastics.** (Bulletin No. 59). Stewart Bolling & Co., Inc., 3190 East 65th St., Cleveland 27, Ohio. 8½ x 11 in. 12 pp.

This revised catalog offers extensive information on intensive mixers. The text opens with a discussion of the company's line of equipment and gives general information on operation, construction and related subjects. The variety of drives offered is illustrated, as are the latest mixers, with their sizes and choice of drives indicated. Specifications are also detailed in graph form. One page, devoted to laboratory equipment, shows a new mixer. The engineering services of the company are also described.

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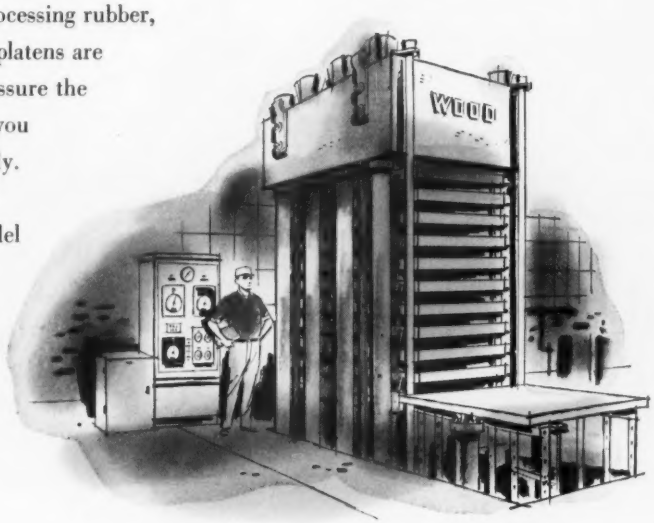


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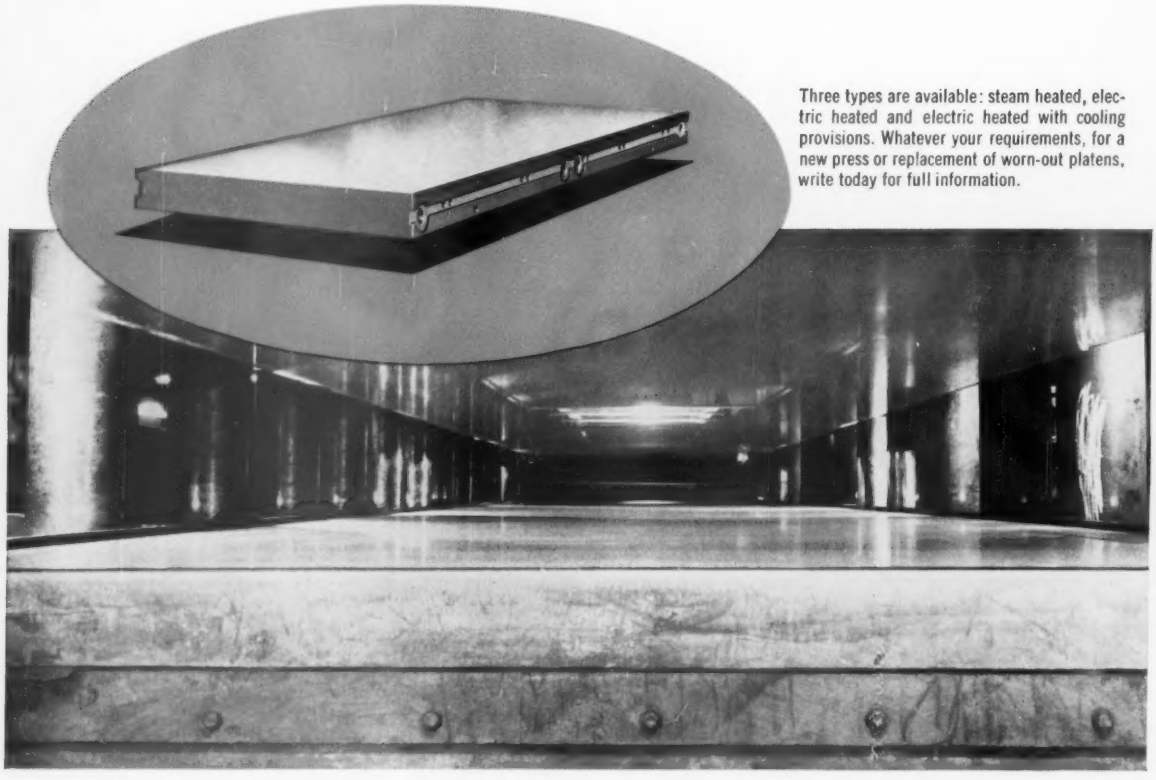

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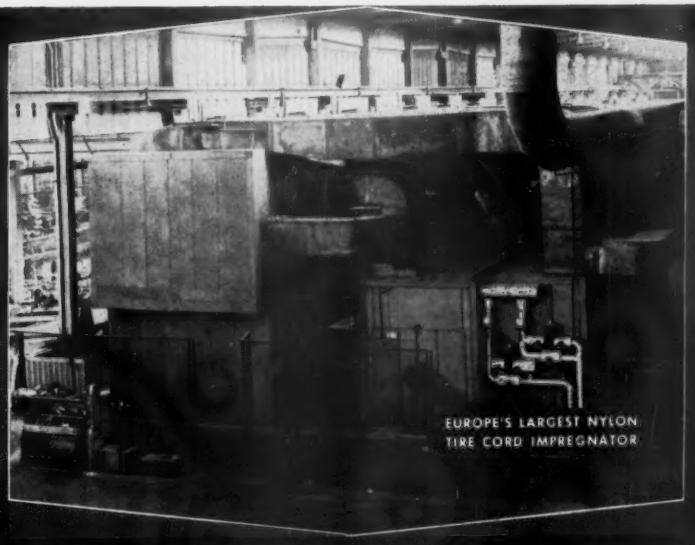

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# MARKET REPORTS

TRENDS
NEWS
PRICES

## Natural Rubber

Since our last report (June 1), the price of natural rubber on the New York Commodity Exchange has moved in a range of 362 points, high for the period being 36.00c reached on June 3, and low being 32.38c reached on June 26. The average price of spot rubber for the month of June was 34.31c based on 22 trading days. This compares with an average of 36.48c in the previous month.

While it has been the impression in the local rubber trade that U.S. liquidation of the stockpile, if any, will be at a rate which should not have too much of a depressing effect on world prices, this view is apparently not shared in the Far East.

Singapore, particularly, has been influenced by rumors of one kind or another about the U.S. rubber stockpile. Some feel that the Singapore nervousness reflects the liberal holdings of rubber by dealers there.

### Long Term Outlook

Analysts at Merrill Lynch, Pierce, Fenner & Smith point out that 1959 could bring one of the world's largest peacetime deficits of supply to demand in history. It is felt that the tonnages lost because of strikes this spring are most likely to be made up. Consumption forecasts are being raised for the third quarter by an appreciable amount.

Although China has reduced its rubber purchases, it is felt that this is a temporary situation. Russian buying for the year is also expected to be high. When these factors are coupled to the situation in the United States where stocks of natural rubber are relatively low, the chances for the projected natural rubber deficit seem good.

It should be noted that stocks of natural rubber are generally low in producing as well as in consuming areas. Rubber consumption in Europe is on the rise. MLPFS analysts note that a deficit may also exist in 1960.

All these matters, however, are made somewhat uncertain by legislation under consideration by the Congress. It seems more than likely at this point that some method of stockpile reduction will be decided upon in the near future.

### Impact of Decision

No matter what plan is decided upon, there will be market reaction. The rubber market is too sensitive an instrument not to be affected by any legislation which will be passed. At this juncture, all ears are tuned to Washington. The next few months will be quite interesting for the natural rubber industry and for the rubber industry as a whole.

*NEW YORK, JULY 1, 1959*

## Price Data

**Closing Rubber Prices on New York Commodity Exchange**

FROM JUNE 1 TO JUNE 30

| June | Spot | July | Sept. | Nov. | Sales |
|---|---|---|---|---|---|
| 1 | 35.63 | 35.41 | 35.15 | 34.80 | 37 |
| 2 | 35.50 | 35.20 | 34.75 | 34.45 | 86 |
| 3 | 36.00 | 35.75 | 35.30 | 35.00 | 35 |
| 4 | 35.63 | 35.40 | 34.95 | 34.60 | 50 |
| 5 | 35.00 | 34.75 | 34.45 | 34.10 | 100 |
| 6 | .... | .... | .... | .... | ... |
| 7 | .... | .... | .... | .... | ... |
| 8 | 35.13 | 34.75 | 34.40 | 34.10 | 32 |
| 9 | 35.13 | 34.90 | 34.60 | 34.47 | 42 |
| 10 | 35.13 | 35.00 | 34.75 | 34.35 | 40 |
| 11 | 34.25 | 33.95 | 33.80 | 33.60 | 130 |
| 12 | 34.00 | 33.65 | 33.52 | 33.40 | 87 |
| 13 | .... | .... | .... | .... | ... |
| 14 | .... | .... | .... | .... | ... |
| 15 | 34.00 | 33.80 | 33.80 | 33.50 | 36 |
| 16 | 34.75 | 34.45 | 34.50 | 34.20 | 69 |
| 17 | 34.63 | 34.40 | 34.35 | 34.20 | 39 |
| 18 | 33.75 | 33.55 | 33.50 | 33.20 | 67 |
| 19 | 34.00 | 33.75 | 33.85 | 33.50 | 85 |
| 20 | .... | .... | .... | .... | ... |
| 21 | .... | .... | .... | .... | ... |
| 22 | 33.50 | 33.20 | 33.30 | 33.10 | 84 |
| 23 | 33.50 | 33.20 | 33.25 | 33.07 | 136 |
| 24 | 32.88 | 32.45 | 32.80 | 32.50 | 101 |
| 25 | 33.13 | 32.61 | 32.95 | 32.65 | 62 |
| 26 | 32.38 | 32.40 | 32.70 | 32.40 | 70 |
| 27 | .... | .... | .... | .... | ... |
| 28 | .... | .... | .... | .... | ... |
| 29 | 33.50 | 32.70 | 33.50 | 33.18 | 87 |
| 30 | 33.38 | 32.80 | 33.35 | 33.00 | 56 |

**Outside Market**

| | |
|---|---|
| No. 1 Ribbed Smoked Sheets: | |
| Spot | .33⅜ |
| Aug. | .33⅜ |
| Sept. | .33⅜ |
| Thin Latex Crepe: | |
| Spot | .34⅞ |
| Thin Brown Crepe, No. 2 | .32⅝ |
| Flat Bark Crepe | .28¾ |

**London Market**
**(Standard Smoked Sheets)**

| | |
|---|---|
| Sept. | 32.09 — 32.23 |
| Oct.-Dec. | 32.09 — 32.38 |

**Singapore Market**
**(Standard Smoked Sheets)**

| | |
|---|---|
| Aug. | 30.90 — 30.98 |

**Middling Upland Quotations**

| | May 29 | June 30 | | |
|---|---|---|---|---|
| | Close | High | Low | Close |
| July | 34.64 | 34.84 | 34.80 | 34.81 |
| Oct. | 32.60 | 32.38 | 32.28 | 32.31 |
| Dec. | 32.60 | 32.36 | 32.32 | 32.34 |

## Notes & Quotes

J. Ward Keener, president of the B. F. Goodrich Co., in a recent address before the American Marketing Association, predicted that by 1970, U.S. population will be in the order of 211 million people. He foresees a gross national product (in terms of 1957 dollars) of $650 billion by 1970 and an increase of disposable income of about 45 per cent. The increase in the total amount of money available for consumer spending will "snowball" he observed.

## Synthetic Rubber

Readers who generally note the tables on "Prices of Commercially Available Synthetic Rubber Polymers" which appear regularly in this publication, will see that we have added a new family of elastomers—the fluoroelastomers. The fact of their addition to the section is significant for it attests to the continuing growth of the synthetic rubber industry as a whole.

Within recent months, chlorinated polyethylene was also added to the listings, and in future months others will be placed in position. The listings continue to grow in other directions, too. Black and oil masterbatches now commercially available are being added each month.

### Opportunity for Choice

The prospective consumer of synthetic rubber now has a greater variety from which to choose than ever before. The great variety of elastomers available contribute in no small way to the vitality of the industry. It is now expected, for example, that synthetic rubber will account for about 65 per cent of all the new rubber consumed in the United States in 1959.

The latest figures available from the Rubber Manufacturers Association show that in May, synthetic rubber enjoyed a 65.44 per cent ratio against the 65.78 per cent in the previous month. It will be remembered that several major rubber companies were hit with a strike during this period. However, the base percentages held by synthetic rubber remained relatively firm during the period.

All classes of synthetic rubber seem to be doing better through the first five months of 1959 than they did in the comparable period of the preceding year. A total of 349,229 long tons of styrene rubber were consumed in the United States in the first five months of this year compared with the 280,290 long tons consumed in the first five months of 1958.

### Specialty Rubbers Up

As for neoprene, 35,835 long tons were consumed in the first five months of 1959 against the 26,681 consumed in the first five months of 1958. A total of 24,910 long tons of butyl were consumed, contrasted with 21,939 long tons in the first five months of the previous year. (The commercial introduction of butyl tires will do much to accelerate consumption of butyl in the balance of the year.)

Nitrile rubber with 14,358 long tons consumed in the first five months of 1959 likewise showed a big jump over the 9,891 long tons consumed in the first five months of the previous year.

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| | | |
|---|---|---|
| **CYURAM*MS** | *Pellets Powder* | Tetramethylthiuram Monosulfide |
| **CYURAM*DS** | *Pellets Powder* | Tetramethylthiuram Disulfide |
| **CYZATE*B** | *50% aqueous dispersion* | Zinc Dibutyl Dithiocarbamate |
| **CYZATE*E** | *50% aqueous dispersion* | Zinc Diethyl Dithiocarbamate |
| **ZMBT** | *Powder* | Zinc Salt of Mercaptobenzothiazole |

*Trademark

CYANAMID **AMERICAN CYANAMID COMPANY** Rubber Chemicals Department Bound Brook, New Jersey

# PRICES OF COMMERCIALLY AVAILABLE SYNTHETIC RUBBER

## Dry Rubber

*(per pound carload)*

### Butadiene-Acrylonitrile Types

| | |
|---|---|
| Butaprene NF | .4900 |
| Butaprene NH | .6500 |
| Butaprene NL | .5000 |
| Butaprene NXM | .5800 |
| Chemigum N1NS | .6400 |
| Chemigum N3NS | .5800 |
| Chemigum N5 | .5800 |
| Chemigum N6 | .5000 |
| Chemigum N6B | .5000 |
| Chemigum N7 | .5000 |
| Chemigum N8 | .5000 |
| Chemigum N600 | .5000 |
| Herecol N-33 | .6800 |
| Hycar 1001 | .5800 |
| Hycar 1002 | .5000 |
| Hycar 1014 | .6000 |
| Hycar 1041 | .5800 |
| Hycar 1042 and 1043 | .5000 |
| Hycar 1051 | .5800 |
| Hycar 1052 | .5000 |
| Hycar 1053 | .5000 |
| Hycar 1072 | .6400 |
| Hycar 1203 | .4600 |
| Hycar 1312 | .5000 |
| Hycar 1411 | .6200 |
| Hycar 1432 | .5900 |
| Hycar 1441 | .6200 |
| Paracril AJ | .4850 |
| Paracril ALT | .5000 |
| Paracril B and BJ | .5000 |
| Paracril BLT and BJLT | .5000 |
| Paracril C and CLT | .5800 |
| Paracril CV | .5900 |
| Paracril D | .6500 |
| Paracril 18-80 | .6000 |
| Paracril OZO | .4600 |
| Polysar Krynac 800 | .5000 |
| Polysar Krynac 801 | .5800 |
| Polysar Krynac 802 | .5000 |
| Polysar Krynac 803 | .5000 |

### Butadiene-Styrene Types

| | |
|---|---|
| Ameripol 1000 | .2410 |
| Ameripol 1001 | .2410 |
| Ameripol 1002 | .2435 |
| Ameripol 1006 | .2410 |
| Ameripol 1006 (crumb) | .2475 |
| Ameripol 1007 | .2410 |
| Ameripol 1009 | .2475 |
| Ameripol 1009 (crumb) | .2590 |
| Ameripol 1011 | .2475 |
| Ameripol 1012 | .2425 |
| Ameripol 1012 (crumb) | .2490 |
| Ameripol 1013 | .2410 |
| Ameripol 1013 (crumb) | .2615 |
| Ameripol 1500 | .2410 |
| Ameripol 1501 | .2410 |
| Ameripol 1502 | .2410 |
| Ameripol 1703 | .2060 |
| Ameripol 1705 | .2035 |
| Ameripol 1707 | .1910 |
| Ameripol 1708 | .1910 |
| Ameripol 1710 | .1885 |
| Ameripol 1712 | .1885 |
| Ameripol 1805 | .1550 |
| Ameripol 4600 | .2410 |
| Ameripol 4650 | .1820 |
| Ameripol 4651 | .1770 |
| Ameripol 4652 | .1425 |
| Ameripol 4654 | .1870 |
| Ameripol 4655 | .1820 |
| Ameripol 4700 | .1750 |
| Ameripol 4750 | .1545 |
| Ameripol 4751 | .1400 |
| Ameripol 4752 | .1600 |
| Ameripol 4753 | .1480 |
| ASRC 1000 | .2410 |
| ASRC 1001 | .2410 |
| ASRC 1004 | .2410 |
| ASRC 1006 | .2410 |
| ASRC 1009 | .2475 |
| ASRC 1018 | .2700 |
| ASRC 1019 | .2650 |
| ASRC 1500 | .2410 |
| ASRC 1502 | .2410 |
| ASRC 1503 | .2625 |
| ASRC 1703 | .2060 |
| ASRC 1708 | .1910 |
| ASRC 1712 | .1885 |
| ASRC 1713 | .1750 |
| ASRC 3105 | .2410 |
| ASRC 3106 | .2410 |
| ASRC 3110 | .2600 |
| Baytown 1600 | .1930 |
| Baytown 1601 | .1930 |
| Baytown 1602 | .1930 |
| Baytown 1801 | .1760 |
| Baytown 1803 | .1740 |
| C-102 (Shell) | .2300 |
| Carbomix 3750 | .1820 |
| Carbomix 3751 | .1545 |
| Carbomix 3752 | .1845 |
| Carbomix 3753 | .1640 |
| Carbomix 3754 | .1770 |
| Carbomix 3755 | .1470 |
| CB-102 (Shell) | .1850 |
| Copo 1500 | .2410 |
| Copo 1502 | .2410 |
| Copo 1505 | .2610 |
| Copo 1712 | .1885 |
| Copo 1773 | .2060 |
| Copo 1778 | .1910 |
| Copo 2109 | .3000 |
| Copo 3900 | .2310 |
| FR-S 123 | .1960 |
| FR-S 127 | .2600 |
| FR-S 141 | .2800 |
| FR-S 146 | .2410 |
| FR-S 154 | .1885 |
| FR-S 155 | .1885 |
| FR-S 158 | .3000 |
| FR-S 173 | .2060 |
| FR-S 178 | .1910 |
| FR-S 179 | .2410 |
| FR-S 181 | .2410 |
| FR-S 1000 | .2410 |
| FR-S 1001 | .2410 |
| FR-S 1004 | .2410 |
| FR-S 1006 | .2410 |
| FR-S 1007 | .2410 |
| FR-S 1009 | .2475 |
| FR-S 1010 | .2600 |
| FR-S 1012 | .2425 |
| FR-S 1013 | .2500 |
| FR-S 1014 | .2810 |
| FR-S 1500 | .2410 |
| FR-S 1502 | .2410 |
| FR-S 1703 | .2060 |
| FR-S 1710 | .1885 |
| FR-S 1712 | .1885 |
| Gentro 1500 | .2410 |
| Gentro 1712 | .1885 |
| Gentro-Jet 9152 | .2080 |
| Gentro-Jet 9153 | .1820 |
| Gentro-Jet 9154 | .1845 |
| Gentro-Jet 9250 | .1580 |
| Gentro-Jet 9251 | .1640 |
| Gentro-Jet 9252 | .1670 |
| Gentro-Jet 9275 | .1500 |
| Naugapol 1016 | .2650 |
| Naugapol 1018 | .2700 |
| Naugapol 1019 | .2650 |
| Naugapol 1021 | .3000 |
| Naugapol 1022 | .2800 |
| Naugapol 1023 | .2850 |
| Naugapol 1503 | .2625 |
| Naugapol 1504 | .2950 |
| OB-102 (Shell) | .1825 |
| OB-104 (Shell) | .1475 |
| OB-106 (Shell) | .1510 |
| OB-110 (Shell) | .1410 |
| OB-111 (Shell) | .1540 |
| OB-113 (Shell) | .1750 |
| Philprene 1000 | .2410 |
| Philprene 1001 | .2410 |
| Philprene 1006 | .2410 |
| Philprene 1009 | .2475 |
| Philprene 1018 | .2700 |
| Philprene 1019 | .2650 |
| Philprene 1500 | .2410 |
| Philprene 1502 | .2410 |
| Philprene 1503 | .2625 |
| Philprene 1601 | .1930 |
| Philprene 1603 | .1940 |
| Philprene 1605 | .1900 |
| Philprene 1703 | .2060 |
| Philprene 1708 | .1910 |
| Philprene 1712 | .1885 |
| Philprene 1803 | .1740 |
| Philprene 1805 | .1550 |
| Plioflex 1006 | .2410 |
| Plioflex 1500C | .2410 |
| Plioflex 1502 | .2410 |
| Plioflex 1507 | .2410 |
| Plioflex 1703 | .2060 |
| Plioflex 1710C | .1885 |
| Plioflex 1712C | .1885 |
| Plioflex 1713 | .1750 |
| Plioflex 1714C | .1725 |
| Plioflex 1773 | .2060 |
| Plioflex 1778 | .1910 |
| Polysar Kryflex 200 | .2510 |
| Polysar Krylene | .2410 |
| Polysar Krylene NS | .2410 |
| Polysar Krynol 651 | .1885 |
| Polysar Krynol 652 | .1910 |
| Polysar S | .2410 |
| Polysar S-50 | .2410 |
| Polysar S-X 371 | .2550 |
| Polysar SS-250 | .2875 |
| S-1000 | .2300 |
| S-1002 | .2325 |
| S-1006 | .2300 |
| S-1009 | .2400 |
| S-1011 | .2325 |
| S-1013 | .2300 |
| S-1100 | .1850 |
| S-1500 | .2300 |
| S-1502 | .2300 |
| S-1600 | .1825 |
| S-1602 | .1825 |
| S-1605 | .1800 |
| S-1703 | .1950 |
| S-1707 | .1800 |
| S-1709 | .1775 |
| S-1712 | .1775 |
| S-1803 | .1650 |
| S-1804 | .1750 |
| S-7701 | .1850 |
| SP-103 (Shell) | .2900 |
| Synpol 1000 | .2410 |
| Synpol 1001 | .2410 |
| Synpol 1002 | .2435 |
| Synpol 1006 | .2410 |
| Synpol 1007 | .2410 |
| Synpol 1009 | .2475 |
| Synpol 1012 | .2425 |
| Synpol 1061 | .2410 |
| Synpol 1500 | .2410 |
| Synpol 1502 | .2410 |
| Synpol 1551 | .2410 |
| Synpol 1703 | .2060 |
| Synpol 1707 | .1910 |
| Synpol 1708 | .1910 |
| Synpol 1711 | .1900 |
| Synpol 1712 | .1885 |
| Synpol 8000 | .2410 |
| Synpol 8150 | .1930 |
| Synpol 8200 | .1910 |
| Synpol 8201 | .1750 |
| Synpol 8250 | .1740 |
| Synpol 8253 | .1584 |
| Synpol 8254 | .1545 |
| Synpol X-274 | .2550 |

### Butyl Rubbers

| | |
|---|---|
| Enjay Butyl 035 and 150 | .2300 |
| Enjay Butyl 165 NS | .2400 |
| Enjay Butyl 215 | .2300 |
| Enjay Butyl 217 | .2300 |
| Enjay Butyl 218 | .2300 |
| Enjay Butyl 268 NS | .2400 |
| Enjay Butyl 325 | .2300 |
| Enjay Butyl 365 NS | .2400 |
| Polysar Butyl 100 | .2450 |
| Polysar Butyl 101 | .2775 |
| Polysar Butyl 200 and 300 | .2450 |
| Polysar Butyl 301 | .2550 |
| Polysar Butyl 400 | .2450 |

### Chlorosulfonated Polyethylene

| | |
|---|---|
| Hypalon 20 | .7000 |
| Hypalon 30 | .7000 |

### Fluoroelastomers

| | |
|---|---|
| Kel-F Fluorel | $15.00 |
| Kel-F 3700 | $16.00 |
| Kel-F 5500 | $16.00 |
| Viton A | $15.00 |
| Viton A-HV | $15.00 |

### Neoprene

| | *(prices l.c.l.)* |
|---|---|
| Neoprene Types AC and CG | .5500 |
| Neoprene Type AD | .5500 |
| Neoprene Type FB | .6500 |
| Neoprene Type GN | .4100 |
| Neoprene Type GN-A | .4100 |
| Neoprene Type GRT | .4200 |
| Neoprene Type KNR | .7500 |
| Neoprene Type S | .4200 |
| Neoprene Type W | .3900 |
| Neoprene Type WB | .4100 |
| Neoprene Type WHV | .3900 |
| Neoprene Type WRT | .4500 |
| Neoprene Type WX | .4100 |

### Polysulfide Rubbers

| | *(prices l.c.l.)* |
|---|---|
| Thiokol Type A | .5000 |
| Thiokol Type FA | .6900 |
| Thiokol Type ST | 1.2500 |

# POLYMERS

## Latex

*(per pound carload)*

### Silicone Rubbers*

| | *(prices f.o.b.)* |
|---|---|
| GE (compounded) | 2.50 [3] |
| GE Silicone Gum (not compounded) | 4.00 [3] |
| Silastic (compounded) | 3.90 [3] |
| Silastic (gums) | 3.85 [3] |
| Union Carbide (gums) | 4.00 [3] |
| Union Carbide (compounds) | 2.50 [3] |

### Butadiene-Styrene Types

| | |
|---|---|
| Butaprene N-300 | .4600 [3] |
| Butaprene N-400 | .5400 [3] |
| Butaprene N-401 | .5400 [3] |
| Chemigum 200 | .4900 [3] |
| Chemigum 235 | .5400 [3] |
| Chemigum 236 | .5400 [3] |
| Chemigum 245 | .4600 [3] |
| Chemigum 246 | .4600 [3] |
| Chemigum 247 | .4600 [3] |
| Chemigum 248 | .4600 [3] |
| CL-101 (Shell) | .2800 [3] |
| Hycar 1512 | .4600 [3] |
| Hycar 1551 | .5400 [3] |
| Hycar 1552 | .4600 [3] |
| Hycar 1561 | .5400 [3] |
| Hycar 1562 | .4600 [3] |
| Hycar 1571 | .5400 [3] |
| Hycar 1572 | .5100 [3] |
| Hycar 1577 | .4600 [3] |
| Hycar 1852 | .4600 [3] |
| Nitrex 2612 | .4600 [1] |
| Nitrex 2614 | .4600 [1] |
| Nitrex 2614-A | .4600 [1] |
| Nitrex 2615 | .5100 [1] |
| Nitrex 2615-A | .5100 [1] |
| Nitrex 2616 | .5400 [1] |
| Nitrex 2617 | .4600 [1] |
| Nitrex 2617-A | .4600 [1] |
| Nitrex 2619 | .5300 [1] |
| Nitrex 2620 | .4600 [1] |
| Nitrex 2625 | .4600 [1] |
| Copo 2101 | .3000 [3] |
| Copo 2102 | .3200 [3] |
| Copo 2105 | .3200 [3] |
| Copo 2108 | .3375 [3] |
| Copo 2110 | .3200 [3] |
| Copo X-800 | .2775 [3] |
| FR-S 2000 | .2775 [3] |
| FR-S 2001 | .2775 [3] |
| FR-S 2002 | .3000 [3] |
| FR-S 2003 | .3050 [3] |
| FR-S 2004 | .3050 [3] |
| FR-S 2006 | .2900 [3] |
| FR-S 2105 | .3200 [3] |
| Naugatex 2000 | .2775 [1] |
| Naugatex 2001 | .2775 [1] |
| Naugatex 2002 | .3000 [1] |
| Naugatex 2006 | .2900 [1] |
| Naugatex 2105 | .3200 [1] |
| Naugatex 2107 | .3200 [1] |
| Naugatex 2108 | .3000 [1] |
| Pliolite 2000 | .2775 [3] |
| Pliolite 2001 | .2775 [3] |
| Pliolite 2076 | .2900 [3] |
| Pliolite 2104 | .3200 [3] |
| Pliolite 2105 | .3200 [3] |
| Pliolite 2107 | .3200 [3] |
| Pliolite 2108 | .3000 [3] |
| S-2000 | .2600 [2] |
| S-2006 | .2600 [2] |
| S-2101 | .2600 [2] |
| S-2105 | .2800 [2] |
| S-2108 | .2900 [2] |

### Neoprene

| | |
|---|---|
| Neoprene Latex 60 | .4000 [3] |
| Neoprene Latex 571 | .3700 [3] |
| Neoprene Latex 572 | .3900 [3] |
| Neoprene Latex 601-A | .4000 [3] |
| Neoprene Latex 673 | .5000 [3] |
| Neoprene Latex 735 | .3800 [3] |
| Neoprene Latex 736 | .3800 [3] |
| Neoprene Latex 842-A | .3700 [3] |
| Neoprene Latex 950 | .4700 [3] |

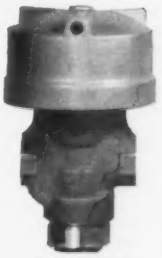
### Polysulfide Rubbers

| | |
|---|---|
| Thiokol Type MX | .8000 [3] |
| Thiokol Type WD-2 | 1.2500 [3] |
| Thiokol Type WD-6 | .8000 [3] |

Notes: (1) Freight allowed. (2) Freight extra. (3) Freight prepaid. *Covers a wide range of compounds. Readers are urged to check specific prices with producers.

Type E370

Type E380



Type D532

Type C172

Type D113

# No Warping No Fouling...

## with Taylor-Emmett NEV-R-GRIND* Valves

**Three-Way (E380) and Two-Way (E370) Valves** are fully balanced, cylinder operated, compact and have excellent capacity. Available in 3500 and 6000 psi body ratings. Both are normally operated at 35 to 50 psi air pressure.

Fully balanced design permits application of pressure to any port connection. Type E370 is available either normally open, or normally closed. Sizes 1" to 4".

**Type D532 Cylinder-Operated Valve** is half the size of conventional valves, has one quarter the parts. Extremely compact and maintenance-free. 750 psi. Sizes ½" to 3". Normally open; normally closed; 3-way semi-balanced.

**Type C172 Diaphragm Valve** is small, sturdy, reliable, easy to maintain. Ideal for Sampling, Condensate Blow Down, air relay operation, etc. 125 psi rating; ¼" and ½" sizes; Brass or 316 s.s. Normally open, normally closed and three-way types.

**Type D113 Diaphragm Valve** for "on-off" service has 300 psi rating. Large seat ring areas, with a maximum flow direction change of 100°, greatly increase flow capacity with reduced pressure drop. Especially adaptable for use with viscous material. 7 sizes between ½" and 3". Bronze, ductile iron or s.s. Normally open, normally closed and three-way types.

### SEND FOR CATALOGS

**Taylor-Emmett High Pressure Valves . . . . Cat. #98323**

**Taylor-Emmett Diaphragm Valves,**

**125 psi . . . . . Cat. #98324**

**300 psi . . . . . Cat. #98325**

**Taylor-Emmett Cylinder Operated Valves,**

**750 psi . . . . . Cat. #98326**

*Call your Taylor Field Engineer, or write Taylor-Emmett Controls, Inc., Akron, Ohio, or Taylor Instrument Companies, Rochester, New York.*

*Trade-Mark

Taylor-Emmett Controls, Inc.

A SUBSIDIARY OF Taylor Instrument Companies

# MARKETS

(continued)

## Reclaimed Rubber

On the basis of figures available to date from the Rubber Manufacturers Association, it appears as if the reclaimed rubber industry will be enjoying one of its better years in 1959. In the first five months of the current year, a total of 120,861 long tons of reclaimed rubber were produced in the United States, against the 101,489 produced in the first five months of the preceding year.

In the first five months of 1959, a total of 120,347 long tons of reclaimed rubber were consumed, contrasted with the 99,074 consumed in the comparable period of the previous year. As of May 31, 1959, there were 22,000 long tons of reclaimed rubber in stocks on hand. On May 31, 1958, there were 27,862 long tons of reclaimed rubber available in stocks.

*(Prices for All Areas Except Calif.)*

| | per lb. |
|---|---|
| Premium Grade Whole Tire | .11⅜ |
| First Line Whole Tire | .11 |
| Second Line Whole Tire | .10½ |
| Third Line Whole Tire | .10¼ |
| Fourth Line Whole Tire | .09¾ |
| Black Carcass | .15¼ |
| No. 1 Light Colored Carcass | .22 |
| No. 1 Peel | .11 |
| Butyl Tube Reclaim | .14 |
| Natural Rubber Black Tube | .16 |
| Natural Rubber Red Tube | .21 |
| Natural Rubber Gray Tube | .21 |

## Scrap Rubber

The scrap rubber industry suffered a temporary setback because of the strike situation which existed in the rubber industry during the past period. Toward the end of the month, however, the market began to display more activity and reclaimers were once again in the market for scrap.

Prices remain at fairly stable levels although synthetic rubber tubes are presently firmer in the East than in the Midwest. The same situation seems to hold true for mixed auto tires.

The Rubber Manufacturers Association reports that in the first five months of this year a total of 110,242 long tons of scrap rubber were consumed in the United States, or approximately 22,000 long tons a month.

*(Prices Delivered Akron)*

| | | |
|---|---|---|
| Mixed tires | ton | 14.00 |
| Light colored carcass | lb. | .04¾ |
| No. 1 peelings | ton | 32.00 |
| No. 2 peelings | ton | 28.00 |
| No. 3 peelings | ton | 23.00 |
| Buffings | ton | 16.00 |
| Truck and Bus S.A.G. | ton | 22.00 |
| Passenger S.A.G. | ton | 20.00 |
| Natural Rubber Red Tubes | lb. | .07¼ |
| Natural Rubber Black Tubes | lb. | .06½ |
| Butyl Rubber Tubes | lb. | .05¼ |

## Tire Fabrics

The running battle between rayon and nylon tire cord continues. It is estimated that some 300 million pounds of rayon and about 125 million pounds of nylon will go into tires in 1959. During the past few years, nylon has made steady progress, moving from about 60 million pounds in 1956 to its current 1959 level.

E. I. du Pont de Nemours & Co., Inc., as a major producer of both nylon and rayon, is in a unique industry position. In order to determine for itself the advantages and disadvantages of rayon and nylon, the company has been running series of tests.

### Long Held Opinion

Company officials point out that as far back as five years ago the company felt that nylon had the greatest potential. After a recently concluded road testing program, DuPont is said to feel even stronger about nylon's potential.

In the road testing program, commercial tires were purchased from regular retail channels, road tested for 15,000 miles and then studied.

DuPont maintains that good tires can be made with either rayon or nylon. The difference depends on how the cord is processed and how it is used in tire construcion. The company states that nylon cord is stronger than rayon to begin with and retains its strength longer during actual use.

It seems to some observers that whatever the technical qualifications involved, the battle between nylon and rayon will continue on economic grounds. Although it takes less nylon than rayon to do the job in a tire, rayon costs less. As a matter of fact, rayon holds some 99 per cent of the original equipment tire market.

*(Prices f.o.b. Shipping Point)*

### Rayon Tire Cord

| | | |
|---|---|---|
| 1100 | lb. | .67½ |
| 1650 | lb. | .67 |
| 2200 | lb. | .67½ |

### Nylon Tire Cord

| | | |
|---|---|---|
| 210 | lb. | 1.96 |
| 840 | lb. | 1.61 |

### Rayon Graded Fabric

| | | |
|---|---|---|
| 1100 | lb. | .69 |
| 1650 | lb. | .63½ |
| 2200 | lb. | .63 |

### Cotton Chafers

| | | | |
|---|---|---|---|
| 8.9 | oz. (per square yard) | lb. | .71 |
| 9.25 | oz. (per square yard) | lb. | .69 |
| 11.65 | oz. (per square yard) | lb. | .63 |
| 14.4 | oz. (per square yard) | lb. | .72 |

## Liquid Latex

**Natural:** Natural rubber latex is now selling at a 40 to 41c level in car load lots at East Coast ports, and at this level can be expected to attract buyers who were reluctant at 43c levels. As with all other types of rubber, the natural latex segment suffered somewhat because of the strike which hit the rubber industry during the past period.

Notwithstanding the strike, however, a total of 33,089 long tons of latex were imported into the U.S. during he first five months of this year and 31,793 long tons were consumed. In the first five months of the preceding year, 30,918 long tons were imported and 26,884 long tons of natural latex were consumed.

Stocks of natural latex on hand continue to be about a one and one-half month consumption level, that is about 8,850 long tons. On May 31, 1958, on the other hand, there were 17,604 long tons in stocks.

**Synthetic:** Synthetic latices, of all types, are doing better in 1959 than in 1958. In the first quarter of this year, for example, 21,244 long tons of S-type latex were consumed in the United States. In the first quarter of the previous year, 14,621 long tons were consumed.

The same situation holds true for neoprene and nitrile latices. In the first three months of 1958, 2,206 long tons of neoprene latex were consumed; in 1959, 2,838 long tons. As for nitrile latex, the figures stand at 3,461 long tons consumed in the first quarter of 1959 against 2,157 long tons in the first quarter of 1958.

## Cotton

The price of middling uplands on the New York Cotton Exchange has moved in a range of 75 points since our last report (June 1), high for the period being 36.25c reached on June 1 and on four other days during the month, and low being 35.50c reached on June 26, 29 and 30. The average price of middling uplands for the month of June was 26.05c based on 22 trading days. This compares with an average of 36.24c in May.

The National Cotton Council in a petition to Agriculture Secretary Benson, has urged that prompt action be taken to curb the interference in domestic cotton markets brought about by imports of foreign textiles which have been mounting in recent years.

The petition states that cotton imported last year in the form of yarn and cloth totaled 93,250 bales. Cotton imports in made-up articles equaled another 193,380 bales for a grand total of 286,630 bales. The Council cited Section 22 of the Agricultural Adjustment Act, which provides relief against imports when they "tend to materially interfere with" agricultural programs established by the Federal government.

For the vital link
in a line
that must not fail...

THIOKOL
POLYSULFIDE
RUBBER

**The rubber connector between wing and wing tip** in the Navy's Chance Vought Crusader jet fighter has a rough assignment. It must resist the aging effects of high powered fuel . . . stay resilient in the low temperatures of high altitudes. And because the wings of the plane fold back when decked, the part must withstand frequent exposure to strong sunlight, salt air and oil.

The Immel Engineering and Development Company, manufacturer of this vital link in the F8U-1 Crusader fuel line, found that one elastomer meets the demands better than any other—THIOKOL polysulfide ST crude.

In scores of industrial applications—where rubber is exposed to degrading elements—THIOKOL ST crude provides long, trouble-free service at low cost. It can be molded or extruded, used alone, in combination with other elastomers, or as a binder for cork and other fibrous materials. For full information, write to THIOKOL at address below.

Thiokol® CHEMICAL CORPORATION

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# STATISTICS of the industry

PERTINENT INDUSTRY DATA

## Natural Rubber in the United States

### (Including Latex and Guayule)

*(All Quantities in Long Tons)*

| Year | New Supply | Consumption | Re-Exports | Stocks On Hand at End of Period |
|---|---|---|---|---|
| 1931 | 501,788 | 355,200 | 25,609 | 322,000 |
| 1932 | 414,668 | 336,700 | 20,937 | 379,000 |
| 1933 | 418,902 | 412,400 | 20,576 | 365,000 |
| 1934 | 463,018 | 462,500 | 23,856 | 355,000 |
| 1935 | 467,146 | 495,500 | 11,391 | 303,000 |
| 1936 | 488,145 | 575,000 | 12,582 | 223,000 |
| 1937 | 600,479 | 543,600 | 7,902 | 262,204 |
| 1938 | 411,983 | 437,031 | 5,652 | 231,500 |
| 1939 | 499,473 | 592,000 | 13,125 | 125,800 |
| 1940 | 818,243 | 648,500 | 7,060 | 288,864 |
| 1941 | 1,029,007 | 775,000 | 5,376 | 533,344 |
| 1942 | 282,653 | 376,791 | 10,856 | 422,714 |
| 1943 | 55,329 | 317,634 | 20,815 | 139,594 |
| 1944 | 107,834 | 144,113 | 9,665 | 93,650 |
| 1945 | 135,672 | 105,429 | 6,743 | 118,715 |
| 1946 | 400,687 | 277,597 | 4,338 | 237,467 |
| 1947 | 688,354 | 562,661 | 4,101 | 129,038 |
| 1948 | 735,227 | 627,332 | 6,673 | 141,541 |
| 1949 | 660,792 | 574,522 | 6,253 | 106,619 |
| 1950 | 802,249 | 720,268 | 8,644 | 89,215 |
| 1951 | 733,048 | 454,015 | 2,603 | 76,569 |
| 1952 | 805,997 | 453,846 | 3,024 | 95,260 |
| 1953 | 647,150 | 553,473 | 8,376 | 112,316 |
| 1954 | 596,848 | 596,285 | 7,443 | 104,543 |
| 1955 | 635,174 | 634,800 | 10,611 | 110,105 |
| 1956 | 580,510 | 563,095 | 11,300 | 115,949 |
| 1957 | 499,121 | 539,761 | 10,146 | 100,901 |
| 1958 | 474,409 | 484,492 | 20,085 | 76,491 |
| 1958: | | | | |
| May | 29,237 | 36,014 | 1,707 | 100,985 |
| June | 28,279 | 37,607 | 1,634 | 91,779 |
| July | 27,521 | 34,235 | 3,107 | 85,577 |
| Aug. | 39,057 | 39,444 | 1,369 | 85,666 |
| Sept. | 38,321 | 44,814 | 1,019 | 82,622 |
| Oct. | 40,267 | 48,957 | 1 550 | 77,859 |
| Nov. | 42,484 | 43,877 | 3,140 | 75,335 |
| Dec. | 57,067 | 46,600 | 2,000 | 75,325 |
| 1959: | | | | |
| Jan. | 54,950 | 49,913 | 1,438 | 82,487 |
| Feb. | 48,917 | 47,345 | 1,561 | 79,657 |
| Mar. | 48,584 | 51,991 | 2,131 | 78,871 |
| Apr. | 34,828 | 40,850 | 1,700 | 78,900 |

Source: U. S. Department of Commerce.

## U. S. Imports of Natural Rubber

| Year | Dry: Long Tons | Dry: Declared Value | Latex: Long Tons | Latex: Declared Value | Total Imports |
|---|---|---|---|---|---|
| 1936 | 467,064 | 152,072,496 | 19,852 | 6,659,899 | 486,916 |
| 1937 | 574,600 | 237,307,041 | 23,185 | 10,213,670 | 597,785 |
| 1938 | 397,640 | 125,373,864 | 11,944 | 4,168,127 | 409,584 |
| 1939 | 469,946 | 167,586,780 | 27,437 | 10,467,552 | 497,383 |
| 1940 | 781,202 | 303,308,823 | 33,789 | 14,593,466 | 814,991 |
| 1941 | 989,498 | 401,976,317 | 34,797 | 15,965,627 | 1,024,245 |
| 1942 | 266,276 | 112,537,426 | 10,646 | 5,630,667 | 276,922 |
| 1943 | 50,358 | 31,369,198 | 1,890 | 1,312,202 | 52,248 |
| 1944 | 103,847 | 73,908,549 | 3,091 | 2,092,211 | 106,938 |
| 1945 | 134,408 | 95,814,102 | 4,773 | 3,115,853 | 139,181 |
| 1946 | 376,502 | 228,796,110 | 8,421 | 5,843,085 | 384,923 |
| 1947 | 691,087 | 306,951,814 | 17,542 | 9,787,722 | 708,629 |
| 1948 | 702,293 | 290,849,177 | 32,745 | 18,288,223 | 735,038 |
| 1949 | 630,808 | 225,343,624 | 29,743 | 14,968,650 | 660,551 |
| 1950 | 747,109 | 416,222,598 | 54,401 | 41,764,486 | 801,510 |
| 1951 | 677,874 | 727,343,348 | 54,963 | 80,178,309 | 732,837 |
| 1952 | 756,987 | 578,179,519 | 48,228 | 40,563,116 | 805,215 |
| 1953 | 571,635 | 284,909,223 | 75,511 | 46,353,333 | 647,146 |
| 1954 | 522,364 | 219,098,143 | 74,483 | 42,755,029 | 596,847 |
| 1955 | 542,507 | 360,435,303 | 92,825 | 80,163,114 | 635,332 |
| 1956 | 499,479 | 334,990,045 | 71,709 | 61,795,844 | 564,321 |
| 1957 | 475,958 | 291,337,628 | 78,567 | 58,249,788 | 554,174 |
| 1958 | 406,059 | 153,127,066 | 67,593 | 45,047,040 | 473,652 |
| 1958: | | | | | |
| Sept. | 36,309 | 16,945,200 | 5,034 | 3,247,978 | 41,343 |
| Oct. | 38,142 | 18,121,031 | 6,994 | 4,676,358 | 45,136 |
| Nov. | 37,345 | 19,262,061 | 4,074 | 3,236,086 | 41,419 |
| Dec. | 46,542 | 25,407,908 | 7,951 | 5,400,581 | 54,493 |
| 1959: | | | | | |
| Jan. | 46,376 | 26,671,747 | 8,574 | 5,982,352 | 54,950 |
| Feb. | 43,171 | 25,654,219 | 5,746 | 3,870,366 | 48,917 |
| Mar. | 41,545 | 24,138,084 | 7,039 | 4,775,577 | 48,584 |

Source: Bureau of the Census, U. S. Department of Commerce.

## World Production of Natural Rubber

### (Including Latex)

*(Long Tons)*

| Year | Malaya | Indonesia | Ceylon | Viet Nam & Cambodia | Laun America* | Rest of World* | Total* |
|---|---|---|---|---|---|---|---|
| 1947 | 646,362 | 277,951 | 89,000 | 38,128 | 34,928 | 172,782 | 1,260,000 |
| 1948 | 698,189 | 432,349 | 95,000 | 43,935 | 29,158 | 225,557 | 1,525,000 |
| 1949 | 671,503 | 432,996 | 89,500 | 43,010 | 27,318 | 225,659 | 1,490,000 |
| 1950 | 694,090 | 696,472 | 113,500 | 48,482 | 26,902 | 280,299 | 1,860,000 |
| 1951 | 605,346 | 814,406 | 105,000 | 52,136 | 29.777 | 278,262 | 1,885,000 |
| 1952 | 584,238 | 750,494 | 96,500 | 63,134 | 35,475 | 261,211 | 1,790,000 |
| 1953 | 574,390 | 692,164 | 98,610 | 74,545 | 35,318 | 250,182 | 1,725,000 |
| 1954 | 584,435 | 738,670 | 93,935 | 78,024 | 26,833 | 280,112 | 1,802,500 |
| 1955 | 639,128 | 733,786 | 93,830 | 80,172 | 6,000 | 344,584 | 1,897,500 |
| 1956 | 568,550 | 686,667 | 95,389 | 89,072 | 22,457 | 336,015 | 1,857,000 |
| 1957 | 638,706 | 684,515 | 98,164 | 58,440 | 28,351 | 381,824 | 1,890,000 |
| 1958 | 663,644 | 614,561 | 100,196 | 103,613 | 26,268 | 446,718 | 1,955,000 |
| 1958: | | | | | | | |
| Nov. | 51,692 | 63,439 | 9,215 | 12,743 | 1,601 | 31,310 | 170,000 |
| Dec. | 71,695 | 67,233 | 11,267 | 14,458 | 1,130 | 31,717 | 197,500 |
| 1959: | | | | | | | |
| Jan. | 64,771 | 42,685 | 9,066 | 9,963 | 500 | 63,015 | 190,000 |
| Feb. | 49,132 | 47,544 | 4,713 | 307 | 500 | 42,804 | 145,000 |

Source: International Rubber Study Group. * Estimated.

## World Consumption of Natural and Synthetic Rubber

### (Including Latex)

*(Long Tons)*

| Year | United States | United Kingdom | Canada | Europe* | Rest of World* | Total* |
|---|---|---|---|---|---|---|
| 1946 | 1,039,296 | 126,770 | 39,196 | 145,000 | 115,804 | 1,467,500 |
| 1947 | 1,122,327 | 156,399 | 61,452 | 242,500 | 153,548 | 1,735,000 |
| 1948 | 1,069,404 | 196,286 | 62,121 | 392,000 | 182,379 | 1,902,500 |
| 1949 | 988,903 | 186,622 | 56,362 | 446,500 | 207,388 | 1,887,500 |
| 1950 | 1,258,557 | 222,425 | 68,695 | 448,500 | 287,055 | 2,285,000 |
| 1951 | 1,214,298 | 238,101 | 70,809 | 476,500 | 314,941 | 2,312,500 |
| 1952 | 1,261,413 | 202,179 | 67,099 | 550,000 | 254,901 | 2,335,000 |
| 1953 | 1,338,309 | 211,453 | 73,394 | 521,000 | 343,606 | 2,500,000 |
| 1954 | 1,233,012 | 247,612 | 71,656 | 544,250 | 408,094 | 2,505,000 |
| 1955 | 1,529,699 | 266,804 | 84,528 | 630,000 | 464,250 | 2,980,000 |
| 1956 | 1,436,482 | 232,345 | 91,458 | 775,500 | 489,215 | 3,025,000 |
| 1957 | 1,464,640 | 239,021 | 88,379 | 777,250 | 565,710 | 3,135,000 |
| 1958 | 1,364,404 | 238,439 | 83,904 | 905,000 | 638,353 | 3,230,000 |
| 1958: | | | | | | |
| Nov. | 122,114 | 19,401 | 8,249 | 76,250 | 53,986 | 280,000 |
| Dec. | 132,391 | 22,733 | 8,064 | 31,500 | 107,812 | 302,500 |
| 1959: | | | | | | |
| Jan. | 139,549 | 21,118 | 7,735 | 87,250 | 59,348 | 315,000 |
| Feb. | 134,738 | 19,456 | 8,879 | ..... | 124,428 | 287,500 |

Source: International Rubber Study Group. * Estimated.

## Rim Production

| | 1954 | 1955 | 1956 | 1957 | 1958 |
|---|---|---|---|---|---|
| Passenger Car | 25,952,322 | 38,092,080 | 27,109,610 | 27,301,567 | 20,665,688 |
| Truck & Bus | 4,463,689 | 6,642,329 | 6,315,428 | 5,468,223 | 3,887,910 |
| Agricultural | 1,279,040 | 1,931,768 | 1,416,938 | 1,368,127 | 1,218,240 |
| Earth Mover | 21,536 | 38,849 | 88,812 | 67,289 | 61,883 |
| Total | 31,734,587 | 46,705,036 | 34,930,788 | 34,205,206 | 25,833,721 |

| | 1958 Dec. | 1959 Jan. | Feb. | Mar. | Apr. | May |
|---|---|---|---|---|---|---|
| Passenger Car | 2,779,148 | 2,497,831 | 2,265,105 | 2,700,787 | 2,603,391 | 2,498,117 |
| Truck and Bus | 456,754 | 395,926 | 448,899 | 589,507 | 604,155 | 501,362 |
| Agricultural | 212,999 | 91,379 | 101,912 | 148,987 | 192,303 | 153,822 |
| Earth Mover | 8,705 | 8,140 | 6,222 | 13,893 | 14,469 | 9,027 |
| Total | 3,457,606 | 2,993,276 | 2,822,138 | 3,453,174 | 3,414,318 | 3,162,328 |

Source: The Tire & Rim Association, Inc.

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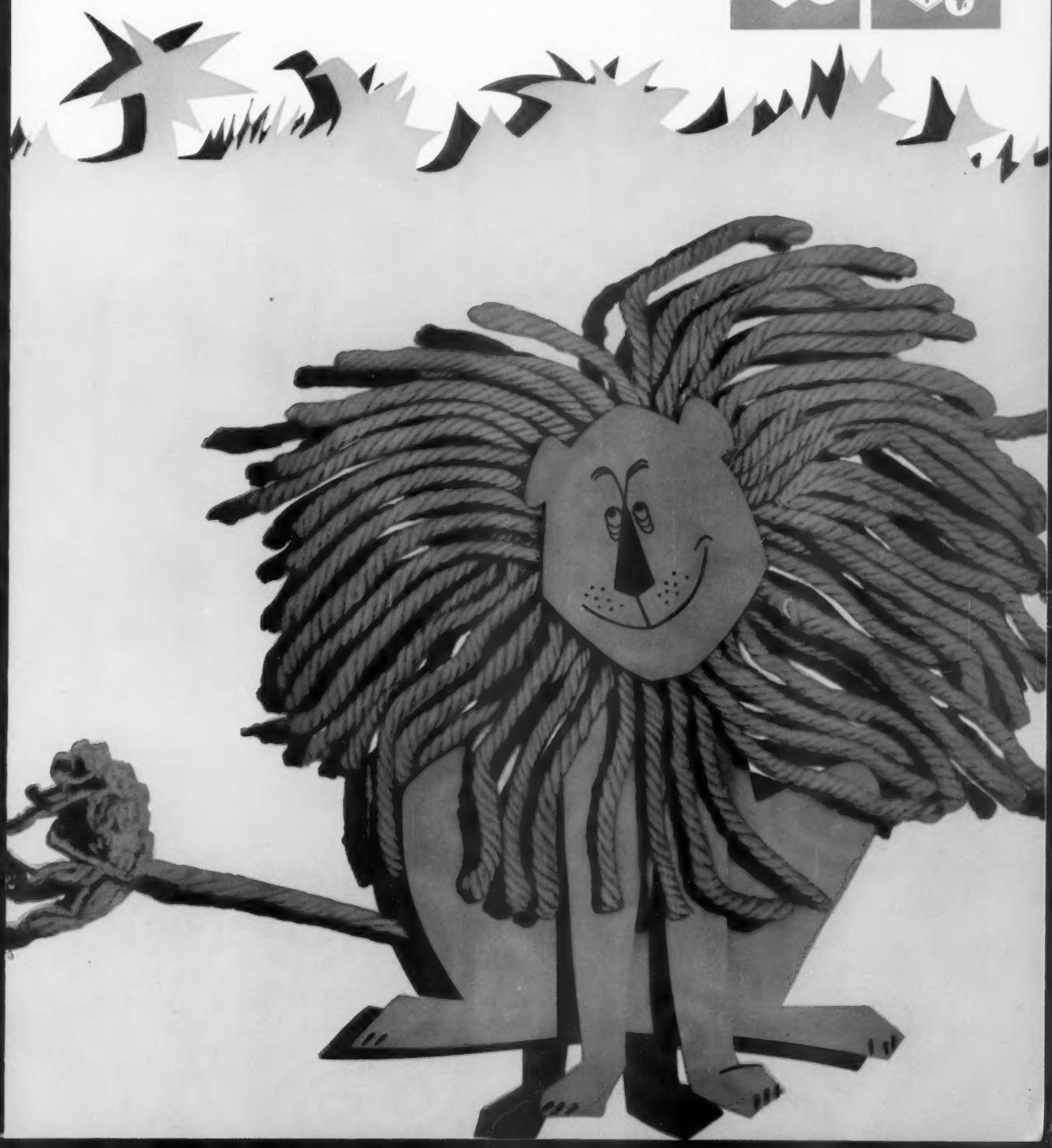

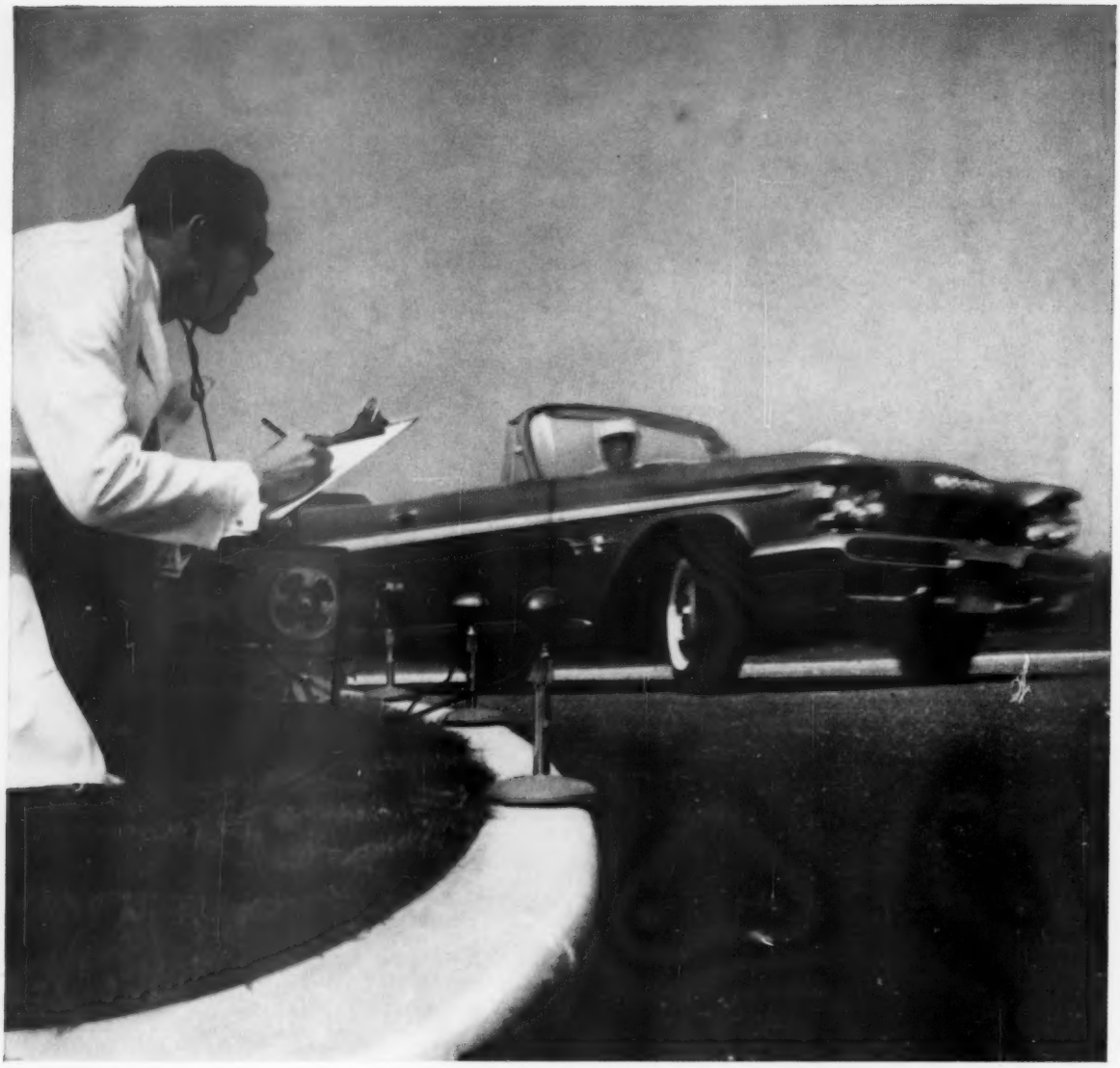

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# HUGS THE ROAD SO WELL YOU CAN'T MAKE IT SCREECH!

The recent advances made in Butyl technology make possible a revolutionary new tire with better traction and superior damping properties, that also allows new freedom in tread and cord design. Butyl thus enables tire manufacturers to produce tires with unique silence, safety, appearance and comfort.

Shown above in one of their exhaustive tests, Butyl tires won't screech at any corner, at any speed . . . at any stop. So effective is their traction, they stop up to 30% faster than ordinary tires . . . *even stop faster on wet surfaces than other tires do on dry.*

Because Butyl absorbs shock energy more completely, Butyl tires literally upgrade the suspension of any car. Detroit engineers report tires of Butyl will help minimize the need for major engineering changes to overcome vibration and noise in tomorrow's new cars.

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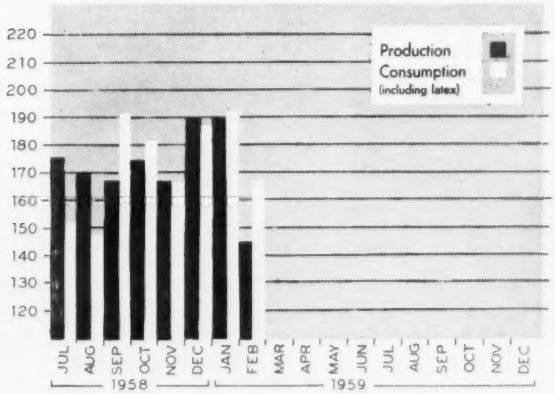
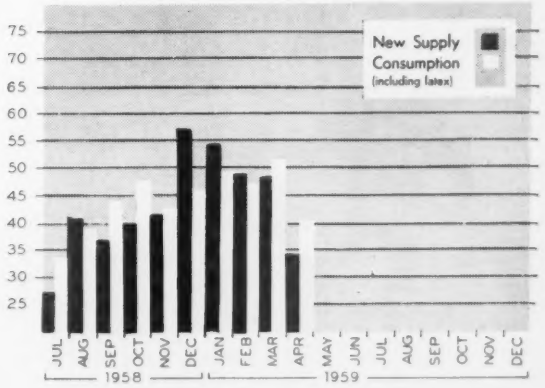
# STATISTICS at a glance

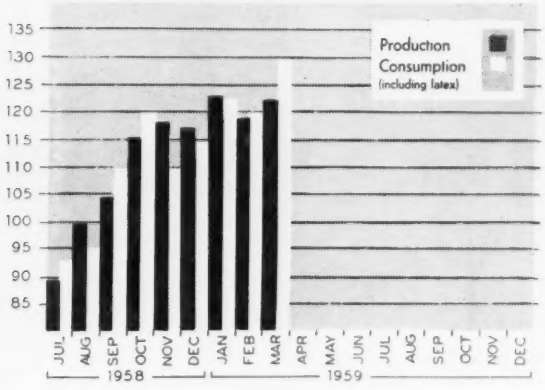
## NATURAL RUBBER—WORLD
(thousands of long tons)



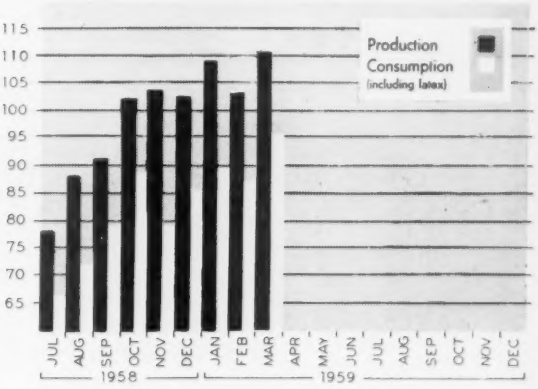

## NATURAL RUBBER—UNITED STATES
(thousands of long tons)



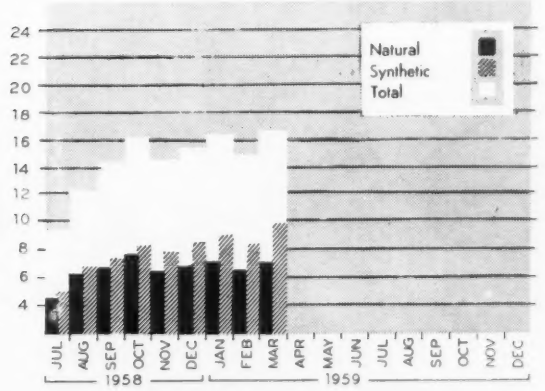

## SYNTHETIC RUBBER—WORLD
(thousands of long tons)



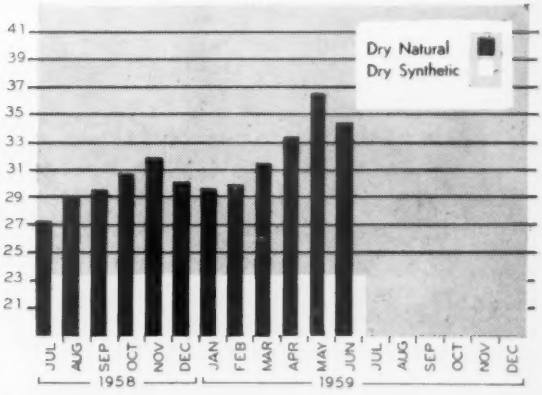

## SYNTHETIC RUBBER—UNITED STATES
(thousands of long tons)




## LATEX CONSUMPTION—UNITED STATES
(thousands of long tons)




## PRICES—NATURAL AND SYNTHETIC
(cents per pound)



# Synthetic Rubber in the United States

*(All Quantities in Long Tons)*

## New Supply

| Year | GR-S | Neoprene | Butyl | N-Type | Total |
|---|---|---|---|---|---|
| **1949** | **310,529** | **35,215** | **54,046** | **11,072** | **410,932** |
| **1950** | **378,887** | **50,067** | **60,915** | **12,037** | **501,906** |
| **1951** | **704,529** | **58,907** | **76,475** | **15,333** | **855,244** |
| **1952** | **654,854** | **65,745** | **81,630** | **16,228** | **818,447** |
| **1953** | **680,728** | **80,495** | **79,801** | **20,198** | **861,222** |
| **1954** | **490,405** | **69,150** | **58,802** | **21,396** | **639,753** |
| **1955** | **801,145** | **91,357** | **56,179** | **32,623** | **982,304** |
| **1956** | **876,982** | **99,412** | **75,873** | **34,547** | **1,086,814** |
| **1957** | **913,321** | **110,721** | **67,418** | **33,618** | **1,125,078** |
| 1958 | 872,565 | 97,806 | 54,113 | 32,431 | 1,056,915 |
| 1958: | | | | | |
| July | 65,570 | 6,248 | 3,907 | 2,221 | 77,946 |
| Aug. | 74,051 | 6,745 | 4,725 | 2,824 | 88,345 |
| Sept. | 75,764 | 8,586 | 4,363 | 3,185 | 91,898 |
| Oct. | 83,601 | 9,283 | 5,527 | 3,652 | 102,063 |
| Nov. | 85,044 | 10,394 | 4,384 | 3,642 | 103,464 |
| Dec. | 86,219 | 9,201 | 4,174 | 3,263 | 102,857 |
| 1959: | | | | | |
| Jan. | 90,622 | 9,991 | 5,305 | 3,304 | 109,222 |
| Feb. | 83,662 | 10,256 | 5,898 | 3,407 | 103,223 |
| Mar. | 91,847 | 9,690 | 6,056 | 3,784 | 111,377 |

## Consumption

| | | | | | |
|---|---|---|---|---|---|
| **1950** | **416,230** | **43,781** | **66,348** | **11,930** | **538,289** |
| **1951** | **626,444** | **48,887** | **70,500** | **13,066** | **758,897** |
| **1952** | **666,420** | **55,522** | **71,229** | **13,866** | **807,037** |
| **1953** | **624,181** | **65,900** | **77,826** | **16,929** | **784,836** |
| **1954** | **500,345** | **57,203** | **61,464** | **17,715** | **636,727** |
| **1955** | **741,997** | **72,876** | **53,991** | **26,035** | **894,899** |
| **1956** | **727,789** | **74,887** | **49,615** | **24,976** | **877,267** |
| **1957** | **767,218** | **75,461** | **55,413** | **25,187** | **923,279** |
| 1958: | 730,196 | 69,694 | 53,432 | 26,590 | 880,912 |
| 1958: | | | | | |
| July | 54,241 | 4,623 | 3,791 | 1,765 | 64,420 |
| Aug. | 59,825 | 5,935 | 4,277 | 2,364 | 72,401 |
| Sept. | 65,256 | 6,647 | 4,725 | 2,538 | 79,166 |
| Oct. | 73,699 | 7,378 | 4,982 | 2,759 | 88,818 |
| Nov. | 66,294 | 6,448 | 4,419 | 2,562 | 79,723 |
| Dec. | 71,731 | 6,955 | 4,897 | 2,606 | 86,189 |
| 1959. | | | | | |
| Jan. | 74,222 | 7,198 | 5,359 | 2,857 | 89,636 |
| Feb. | 72,558 | 6,885 | 5,256 | 2,694 | 87,393 |
| Mar. | 78,792 | 7,444 | 5,687 | 3,166 | 95,089 |

## Exports

| | | | | | |
|---|---|---|---|---|---|
| **1950** | **900** | **4,826** | **31** | **1,895** | **7,652** |
| **1951** | **483** | **6,825** | **216** | **1,725** | **9,249** |
| **1952** | **9,467** | **9,813** | **126** | **2,695** | **22,101** |
| **1953** | **7,692** | **11,494** | **237** | **3,245** | **22,668** |
| **1954** | **11,069** | **12,062** | **2,831** | **4,155** | **30,117** |
| **1955** | **60,704** | **18,098** | **9,895** | **4,593** | **93,290** |
| **1956** | **112,366** | **21,909** | **8,699** | **6,194** | **149,168** |
| **1957** | **157,977** | **30,242** | **8,748** | **6,377** | **203,344** |
| 1958 | 142,069 | 31,337 | 13,793 | 6,718 | 193,917 |
| **1958:** | | | | | |
| **July** | 10,602 | 2,403 | 1,051 | 674 | 14,730 |
| **Aug.** | 8,521 | 2,603 | 972 | 558 | 12,654 |
| **Sept.** | 8,802 | 2,774 | 812 | 518 | 12,906 |
| **Oct.** | 12,292 | 2,547 | 1,407 | 553 | 16,799 |
| **Nov.** | 11,872 | 3,010 | 1,306 | 639 | 28,527 |
| **Dec.** | 12,634 | 2,484 | 1,258 | 520 | 16,896 |
| 1959: | | | | | |
| Jan. | 11,962 | 3,430 | 1,579 | 520 | 17,491 |
| Feb. | 11,615 | 2,404 | 1,169 | 648 | 15,836 |

## Stocks

| | | | | | |
|---|---|---|---|---|---|
| 1949 | 77,731 | 4,654 | 12,224 | 3,433 | 98,042 |
| 1950 | 36,942 | 5,733 | 7,243 | 2,840 | 52,758 |
| **1951** | **105,271** | **8,379** | **12,481** | **3,821** | **129,912** |
| **1952** | **83,861** | **8,535** | **22,716** | **3,875** | **118,987** |
| **1953** | **135,153** | **11,480** | **24,866** | **4,346** | **175,845** |
| **1954** | **115,499** | **11,349** | **19,267** | **4,280** | **150,395** |
| **1955** | **108,989** | **12,220** | **10,500** | **6,030** | **137,739** |
| **1956** | **151,763** | **14,077** | **28,744** | **7,934** | **202,518** |
| **1957** | **140,199** | **18,843** | **31,489** | **7,454** | **197,985** |
| 1958 | 143,533 | 15,688 | 18,770 | 7,292 | 185,283 |
| **1958:** | | | | | |
| **Sept.** | 138,987 | 15,154 | 22,554 | 6,145 | 182,840 |
| **Oct.** | 134,613 | 15,474 | 22,091 | 6,356 | 178,534 |
| **Nov.** | 140,673 | 15,373 | 20,192 | 7,273 | 183,511 |
| **Dec.** | 143,533 | 15,688 | 18,770 | 7,292 | 185,283 |
| 1959: | | | | | |
| Jan. | 147,243 | 15,638 | 16,827 | 7,335 | 187,043 |
| Feb. | 148,606 | 15,990 | 16,339 | 7,468 | 188,403 |
| Mar. | 146,971 | 14,701 | 14,441 | 7,753 | 183,866 |

Source: U. S. Department of Commerce.

# Natural and Synthetic Rubber Latex in the United States

*(All Quantities in Long Tons)*

## New Supply

| Year | Natural | GR-S | Neoprene | N-Type | Total Synthetic | Grand Total |
|---|---|---|---|---|---|---|
| **1945** | **4,768** | **15,176** | **7,077** | ..... | **22,253** | **27,021** |
| **1946** | **8,012** | **24,810** | **13,595** | ..... | **38,405** | **46,417** |
| **1947** | **17,675** | **22,474** | **6,089** | ..... | **28,563** | **46,238** |
| **1948** | **32,630** | **21,494** | **5,022** | ..... | **26,516** | **59,146** |
| **1949** | **29,974** | **21,357** | **3,651** | ..... | **25,008** | **54,982** |
| **1950** | **54,401** | **31,339** | **5,725** | ..... | **37,064** | **91,465** |
| **1951** | **54,963** | **32,972** | **6,866** | **2,948** | **42,786** | **97,749** |
| **1952** | **48,228** | **42,273** | **7,598** | **4,164** | **54,035** | **102,263** |
| **1953** | **75,511** | **48,112** | **9,026** | **5,844** | **62,982** | **138,493** |
| **1954** | **74,483** | **48,379** | **8,214** | **6,866** | **63,459** | **137,942** |
| **1955** | **92,754** | **69,364** | **10,432** | **10,798** | **90,594** | **183,348** |
| **1956** | **72,013** | **69,720** | **10,642** | **10,650** | **91,012** | **163,025** |
| **1957** | **72,252** | **74,535** | **10,403** | **11,420** | **96,358** | **168,610** |
| 1958 | 67,591 | 65,669 | 10,679 | 11,560 | 87,908 | 155,499 |
| 1958: | | | | | | |
| **May** | **4,121** | **3,635** | **808** | **882** | **5,325** | **9,446** |
| **June** | **4,323** | **4,539** | **696** | **890** | **6,125** | **10,448** |
| **July** | **3,158** | **3,645** | **677** | **893** | **5,215** | **8,373** |
| **Aug.** | **5,140** | **5,474** | **892** | **1,103** | **7,469** | **12,609** |
| Sept. | 5,034 | 6,165 | 1,075 | 1,173 | 8,413 | 13,447 |
| Oct. | 6,994 | 7,617 | 1,170 | 1,308 | 10,095 | 17,089 |
| Nov. | 4,074 | 7,307 | 1,156 | 1,205 | 9,668 | 13,742 |
| Dec. | 7,950 | 6,891 | 986 | 1,033 | 8,910 | 16,860 |
| 1959: | | | | | | |
| Jan. | 8,574 | 7,801 | 1,049 | 1,104 | 9,954 | 18,528 |
| Feb. | 5,746 | 7,578 | 998 | 1,161 | 9,737 | 15,483 |
| Mar. | 7,039 | 8,587 | 1,013 | 1,269 | 10,869 | 17,908 |

## Consumption[1]

| | | | | | | |
|---|---|---|---|---|---|---|
| **1945** | **3,886** | **14,500** | **6,800** | .... | **21,300** | **25,186** |
| **1946** | **5,714** | **23,500** | **13,000** | .... | **36,500** | **42,214** |
| **1947** | **13,909** | **22,500** | **6,500** | .... | **29,000** | **42,909** |
| **1948** | **28,489** | **21,500** | **5,250** | .... | **26,750** | **55,239** |
| **1949** | **36,117** | **21,500** | **3,750** | .... | **25,250** | **61,367** |
| **1950** | **56,138** | **31,000** | **5,500** | .... | **36,500** | **92,638** |
| **1951** | **46,750** | **31,031** | **6,279** | **2,628** | **39,938** | **86,688** |
| **1952** | **53,567** | **40,562** | **7,368** | **3,093** | **51,023** | **104,590** |
| **1953** | **67,375** | **46,473** | **7,981** | **3,654** | **58,108** | **125,483** |
| **1954** | **75,931** | **44,173** | **7,251** | **4,507** | **55,931** | **131,862** |
| **1955** | **86,478** | **63,982** | **8,736** | **8,495** | **81,213** | **167,691** |
| **1956** | **74,082** | **62,762** | **8,708** | **8,021** | **79,491** | **153,573** |
| **1957** | **75,009** | **68,305** | **9,039** | **8,630** | **85,974** | **160,983** |
| 1958 | 70,183 | 60,283 | 9,555 | 10,549 | 80,387 | 150,570 |
| 1958: | | | | | | |
| May | 4,951 | 4,102 | 833 | 777 | 5,712 | 10,663 |
| June | 5,248 | 4,165 | 678 | 898 | 5,741 | 10,989 |
| July | 4,483 | 3,433 | 667 | 687 | 4,787 | 9,270 |
| Aug. | 6,030 | 4,654 | 811 | 1,001 | 6,466 | 12,496 |
| Sept. | 6,677 | 5,779 | 870 | 993 | 7,642 | 14,319 |
| Oct. | 7,643 | 6,534 | 1,039 | 1,094 | 8,667 | 16,310 |
| Nov. | 6,470 | 6,009 | 847 | 1,082 | 7,938 | 14,408 |
| Dec. | 6,748 | 6,893 | 854 | 1,081 | 8,828 | 15,576 |
| 1959: | | | | | | |
| Jan. | 7,184 | 6,886 | 925 | 1,244 | 9,055 | 16,239 |
| Feb. | 6,489 | 7,083 | 859 | 1,009 | 8,951 | 15,440 |
| Mar. | 7,052 | 7,275 | 1,054 | 1,208 | 9,537 | 16,589 |

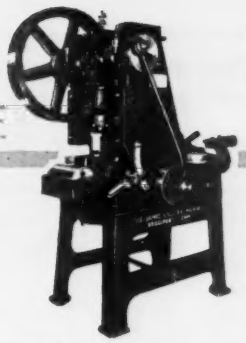
## Stocks at End of Period

| | | | | | | |
|---|---|---|---|---|---|---|
| **1945** | **3,121** | .... | .... | .... | .... | **3,121** |
| **1946** | **4,865** | .... | .... | .... | .... | **4,865** |
| **1947** | **5,033** | .... | .... | .... | .... | **5,033** |
| **1948** | **11,235** | .... | .... | .... | .... | **11,235** |
| **1949** | **5,063** | .... | .... | .... | .... | **5,063** |
| **1950** | **4,927** | .... | .... | .... | .... | **4,927** |
| **1951** | **4,752** | **3,727** | **1,245** | **532** | **5,504** | **10,256** |
| **1952** | **6,201** | **5,040** | **1,019** | **902** | **6,961** | **13,162** |
| **1953** | **13,532** | **4,794** | **1,117** | **721** | **6,632** | **20,164** |
| **1954** | **11,133** | **5,134** | **1,087** | **811** | **7,032** | **18,165** |
| **1955** | **13,203** | **6,980** | **1,236** | **1,807** | **10,203** | **23,406** |
| **1956** | **12,064** | **7,451** | **1,384** | **1,558** | **10,393** | **22,457** |
| **1957** | **14,454** | **8,347** | **1,267** | **1,974** | **11,588** | **26,042** |
| 1958 | 8,900 | 7,672 | 1,663 | 2,519 | 11,854 | 20,754 |
| 1958: | | | | | | |
| May | 17,604 | 7,240 | 1,292 | 1,732 | 10,264 | 27,868 |
| June | 17,078 | 7,337 | 1,267 | 1,888 | 10,492 | 27,570 |
| **July** | **15,516** | **6,693** | **1,312** | **1,990** | **9,995** | **25,511** |
| **Aug.** | **13,750** | **7,166** | **1,195** | **2,049** | **10,410** | **24,160** |
| Sept. | 12,482 | 6,842 | 1,354 | 2,096 | 10,616 | 23,098 |
| Oct. | 10,324 | 7,129 | 1,365 | 2,229 | 10,376 | 20,700 |
| Nov. | 8,795 | 7,810 | 1,498 | 2,530 | 11,838 | 20,633 |
| Dec. | 8,900 | 7,672 | 1,663 | 2,519 | 11,854 | 20,754 |
| 1959: | | | | | | |
| Jan. | 10,025 | 7,822 | 1,551 | 2,418 | 11,791 | 21,816 |
| Feb. | 10,482 | 7,753 | 1,488 | 2,535 | 11,776 | 22,258 |
| Mar. | 9,375 | 8,209 | 1,441 | 2,670 | 12,320 | 21,695 |

Source: U. S. Department of Commerce.
Note: (1) GR-S and Neoprene consumption estimated through 1950.

# COULTER Cutting Machines set the standard!

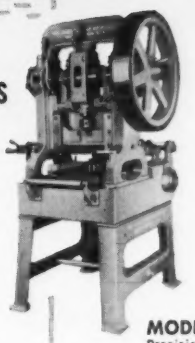
*Finest in Rubber Cutting Machines Since 1896*



**MODEL A1**
Precision cutting for both high speed production or short runs.

**PRECISION RUBBER CUTTING MACHINES CUT WITH OR ACROSS STOCK GRAIN**

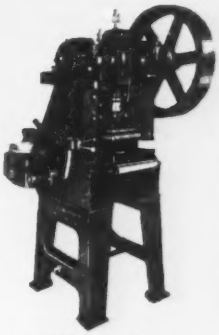
- Peak production loads
- Short runs
- Multiple heels and taps
- Half and full soles
- Mechanical rubber goods



***A COULTER Rubber Cutter saves in 2 most important ways***

*First, you enjoy greater production with cutting speeds at rates up to 15,000 pieces per hour.*

*Second, lower maintenance; Coulter rubber cutters are job-designed to last longer and to cut at top efficiency for year-after-year of trouble-free service.*



**MODEL A2**
Precision cutting for multiple heels, half and full soles with stock grain.

**MODEL A3**
Precision cutting of multiple heels and taps with or across stock grain.

*the James* **COULTER** *Machine Co.*
BRIDGEPORT, CONN.

*Recognized and respected throughout the entire world for 63 years.*

**See your local distributor or write today for full information.**

# Manufacturers of CANARY LINERS

Mildew-proofing *and* Flame-proofing Cotton Fabrics as per Government Specifications. *Write or Wire for Samples and Quotations.*

**EXPORT AGENT**
Columbian Carbon, International, Inc.
380 Madison Ave., New York 17, N. Y.

**CANADIAN AGENT**
Columbian Carbon (Canada) Ltd.,
33 Edward St., Toronto 3, Ontario, Canada

## J. J. WHITE Products Co.
7000 UNION AVENUE
CLEVELAND 5 OHIO

## Automotive Pneumatic Casings

*(Thousands of Units)*

| | Shipments | | | | | |
|---|---|---|---|---|---|---|
| | Original Equipment | Replacement | Export | Total | Production | Inventory End of Period |
| 1951 (total) .... | 32,153 | 44,612 | 1,677 | 78,442 | 83,405 | 8,765 |
| Passenger Car | 26,729 | 34,226 | 723 | 61,678 | 65,546 | 6,973 |
| Truck and Bus | 5,424 | 10,386 | 954 | 16,764 | 17,859 | 1,791 |
| 1952 (total) .... | 29,484 | 54,342 | 1,520 | 85,346 | 90,411 | 14,110 |
| Passenger Car | 24,106 | 45,458 | 741 | 70,305 | 74,341 | 11,251 |
| Truck and Bus | 5,378 | 8,884 | 779 | 15,041 | 16,070 | 2,859 |
| 1953 (total) .... | 37,949 | 55,124 | 1,543 | 94,617 | 96,150 | 15,720 |
| Passenger Car | 33,106 | 45,798 | 809 | 79,713 | 81,455 | 13,044 |
| Truck and Bus | 4,843 | 9,326 | 734 | 14,904 | 14,696 | 2,676 |
| 1954 (total) .... | 33,333 | 55,155 | 1,753 | 90,241 | 89,141 | 14,762 |
| Passenger Car | 29,741 | 47,044 | 928 | 77,713 | 76,794 | 12,217 |
| Truck and Bus | 3,591 | 8,111 | 826 | 12,528 | 12,347 | 2,545 |
| 1955 (total) .... | 47,374 | 59,246 | 1,879 | 108,499 | 112,178 | 18,778 |
| Passenger Car | 42,574 | 50,189 | 966 | 93,730 | 97,223 | 15,963 |
| Truck and Bus | 4,800 | 9,057 | 912 | 14,769 | 14,955 | 2,815 |
| 1956 (total) .... | 35,422 | 62,146 | 1,757 | 99,325 | 100,406 | 79,872 |
| Passenger Car | 30,873 | 53,252 | 875 | 85,000 | 85,546 | 16,494 |
| Truck and Bus | 4,548 | 8,894 | 883 | 14,325 | 14,859 | 3,378 |
| 1957 (total) .... | 36,765 | 65,150 | 1,733 | 103,649 | 106,940 | 250,536 |
| Passenger Car | 32,725 | 56,603 | 889 | 90,217 | 93,542 | 210,146 |
| Truck and Bus | 4,053 | 8,546 | 846 | 13,432 | 13,398 | 40,384 |
| 1958 (total) .... | 26,783 | 70,797 | 1,348 | 98,928 | 96,563 | 20,939 |
| Passenger Car | 23,408 | 61,570 | 717 | 85,696 | 83,636 | 17,778 |
| Truck and Bus | 3,375 | 9,226 | 631 | 13,232 | 12,927 | 3,161 |
| 1958: | | | | | | |
| May (total) .... | 2,173 | 6,220 | 110 | 8,503 | 7,653 | 21,834 |
| Passenger Car | 1,874 | 5,593 | 56 | 7,523 | 6,715 | 18,263 |
| Truck and Bus | 299 | 626 | 54 | 980 | 938 | 3,571 |
| June (total) .... | 1,932 | 7,182 | 117 | 9,231 | 8,293 | 20,920 |
| Passenger Car | 1,667 | 6,387 | 63 | 8,117 | 7,306 | 17,465 |
| Truck and Bus | 265 | 794 | 54 | 1,113 | 988 | 3,456 |
| July (total) .... | 2,020 | 7,442 | 111 | 9,573 | 7,288 | 18,615 |
| Passenger Car | 1,756 | 6,502 | 60 | 8,318 | 6,368 | 15,501 |
| Truck and Bus | 265 | 940 | 51 | 1,255 | 920 | 3,114 |
| Aug. (total) .... | 1,055 | 6,679 | 115 | 7,848 | 7,762 | 18,521 |
| Passenger Car | 847 | 5,807 | 57 | 6,711 | 6,753 | 15,535 |
| Truck and Bus | 208 | 871 | 57 | 1,137 | 1,009 | 2,986 |
| Sept. (total) .... | 1,442 | 6,365 | 105 | 7,912 | 8,277 | 18,925 |
| Passenger Car | 1,170 | 5,425 | 64 | 6,659 | 7,134 | 16,045 |
| Truck and Bus | 273 | 940 | 41 | 1,253 | 1,143 | 2,880 |
| Oct. (total) .... | 1,838 | 6,476 | 140 | 8,454 | 9,344 | 19,913 |
| Passenger Car | 1,522 | 5,369 | 81 | 6,972 | 7,983 | 17,134 |
| Truck and Bus | 316 | 1,106 | 59 | 1,482 | 1,361 | 2,779 |
| Nov. (total) .... | 3,369 | 4,320 | 100 | 7,788 | 8,393 | 20,403 |
| Passenger Car | 3,056 | 3,651 | 58 | 6,765 | 7,182 | 17,420 |
| Truck and Bus | 313 | 669 | 42 | 1,023 | 1,211 | 2,983 |
| Dec. (total) .... | 4,057 | 4,711 | 124 | 8,892 | 9,376 | 20,939 |
| Passenger Car | 3,701 | 3,977 | 61 | 7,739 | 8,046 | 17,778 |
| Truck and Bus | 356 | 734 | 63 | 1,153 | 1,330 | 3,161 |
| 1959: | | | | | | |
| Jan. (total) .... | 2,960 | 6,742 | 104 | 9,806 | 10,184 | 21,399 |
| Passenger Car | 2,631 | 6,028 | 57 | 8,716 | 8,859 | 17,998 |
| Truck and Bus | 329 | 714 | 47 | 1,090 | 1,325 | 3,401 |
| Feb. (total) .... | 2,805 | 5,611 | 135 | 8,551 | 10,270 | 23,019 |
| Passenger Car | 2,442 | 4,932 | 60 | 7,434 | 8,962 | 19,435 |
| Truck and Bus | 364 | 679 | 74 | 1,117 | 1,308 | 3,584 |
| Mar. total) .... | 3,336 | 7,103 | 117 | 10,557 | 11,350 | 23,862 |
| Passenger Car | 2,930 | 6,261 | 62 | 9,253 | 9,959 | 20,181 |
| Truck and Bus | 406 | 842 | 56 | 1,304 | 1,391 | 3,680 |
| Apr. (total) .... | 3,594 | 7,297 | 109 | 10,999 | 8,025 | 20,872 |
| Passenger Car | 3,115 | 6,390 | 65 | 9,569 | 6,986 | 17,597 |
| Truck and Bus | 479 | 907 | 44 | 1,430 | 1,039 | 3,276 |

Source: The Rubber Manufacturers Association, Inc.

## Automobile Production in U. S.

**(Civilian Production Only)**

| Year | Passenger Cars | Trucks | Total | Year | Passenger Cars | Trucks | Total |
|---|---|---|---|---|---|---|---|
| 1939 | 2,866,796 | 704,308 | 3,571,104 | 1949 | 5,108,841 | 1,123,736 | 6,232,577 |
| 1940 | 3,692,328 | 721,637 | 4,413,965 | 1950 | 6,665,836 | 1,332,263 | 7,998,099 |
| 1941 | 3,744,500 | 875,381 | 4,619,681 | 1951 | 5,337,729 | 1,420,432 | 6,758,161 |
| 1942 | 220,814 | 133,083 | 353,897 | 1952 | 4,320,794 | 1,212,790 | 5,533,584 |
| 1943 | 0 | 4,501 | 4,501 | 1953 | 6,121,787 | 1,202,196 | 7,323,983 |
| 1944 | 0 | 124,819 | 124,819 | 1954 | 5,558,897 | 1,038,045 | 6,596,942 |
| 1945 | 83,792 | 313,643 | 397,435 | 1955 | 7,920,186 | 1,245,018 | 9,165,204 |
| 1946 | 2,148,699 | 930,760 | 3,079,429 | 1956 | 5,816,109 | 1,100,417 | 6,916,526 |
| 1947 | 3,558,178 | 1,220,634 | 4,778,812 | 1957 | 6,113,344 | 1,097,006 | 7,210,350 |
| 1948 | 3,909,270 | 1,363,856 | 5,132,090 | 1958 | 4,257,812 | 874,278 | 5,132,090 |
| 1958: | | | | | | | |
| Jan. | 478,416 | 79,790 | 558,206 | July | 316,408 | 65,047 | 381,455 |
| Feb. | 396,221 | 71,024 | 467,245 | Aug. | 194,974 | 55,221 | 250,195 |
| Mar. | 359,464 | 73,658 | 433,122 | Sept. | 102,687 | 46,353 | 149,040 |
| Apr. | 322,482 | 73,886 | 396,368 | Oct. | 272,241 | 69,934 | 342,175 |
| May | 352,076 | 75,291 | 427,367 | Nov. | 511,885 | 93,282 | 605,167 |
| June | 342,228 | 70,652 | 412,880 | Dec. | 608,730 | 100,140 | 708,870 |
| 1959: | | | | | | | |
| Jan. | 539,451 | 96,044 | 635,495 | July | ..... | ..... | ..... |
| Feb. | 476,977 | 99,973 | 576,950 | Aug. | ..... | ..... | ..... |
| Mar. | 575,012 | 111,355 | 686,367 | Sept. | ..... | ..... | ..... |
| Apr. | 585,789 | 116,910 | 702,699 | Oct. | ..... | ..... | ..... |
| May | ..... | ..... | ..... | Nov. | ..... | ..... | ..... |
| June | ..... | ..... | ..... | Dec. | ..... | ..... | ..... |

Source: Automobile Manufacturers Association.

Note: Figures are based on factory sales. Revisions are made from time to time in these figures and the latest issue should be consulted for accuracy.

## Automotive Inner Tubes

*(Thousands of Units)*

| | Shipments | | | | | |
|---|---|---|---|---|---|---|
| Year | Original Equipment | Replacement | Export | Total | Production | Inventory End of Period |
| 1946 | 15,327 | 59,357 | 1,424 | 76,108 | 77,251 | 3,820 |
| 1947 | 25,046 | 46,560 | 2,483 | 74,088 | 79,181 | 8,059 |
| 1948 | 26,833 | 40,548 | 1,119 | 68,499 | 70,033 | 9,641 |
| 1949 | 31,521 | 31,450 | 887 | 63,858 | 65,114 | 10,657 |
| 1950 | 41,240 | 42,671 | 81: | 84,723 | 80,179 | ... |
| 1951 | 32,151 | 32,284 | 1,071 | 65,507 | 67,249 | 10,094 |
| 1952 | 29,451 | 32,985 | 1,014 | 53,449 | 65,073 | 12,036 |
| 1953 | 37,957 | 36,072 | 878 | 74,907 | 74,425 | 11,874 |
| 1954 | 25,071 | 35,576 | 945 | 61,593 | 48,279 | 9,519 |
| 1955 | 5,001 | 33,387 | 1,001 | 39,389 | 35,900 | 6,833 |
| 1956 | 3,100 | 32,358 | 1,040 | 36,498 | 34,405 | 6,109 |
| 1957 | 3,046 | 35,687 | 1,076 | 39,806 | 39,774 | 80,077 |
| 1958 | 2,678 | 37,872 | 870 | 41,420 | 41,266 | 8,602 |
| 1958: | | | | | | |
| July | 215 | 3,174 | 76 | 3,466 | 2,890 | 7,680 |
| Aug. | 160 | 3,097 | 74 | 3,331 | 3,305 | 7,664 |
| Sept. | 207 | 3,228 | 63 | 3,498 | 3,390 | 7,657 |
| Oct. | 244 | 3,238 | 84 | 3,567 | 3,768 | 7,869 |
| Nov. | 264 | 2,575 | 60 | 2,899 | 3,319 | 8,372 |
| Dec. | 288 | 3,029 | 94 | 3,411 | 3,491 | 8,602 |
| 1959: | | | | | | |
| Jan. | 287 | 4,450 | 63 | 4,800 | 3,806 | 7,536 |
| Feb. | 311 | 3,924 | 81 | 4,316 | 4,094 | 7,364 |
| Mar. | 339 | 4,013 | 83 | 4,435 | 4,459 | 7,629 |
| Apr. | 389 | 3,474 | 66 | 3,928 | 3,380 | 7,219 |

Source: The Ruboer Manufacturers Association, Inc.

## Vinyl and Vinyl Copolymer Resins—Sales

*(Thousands of Pounds—Resin Content)*

| | Polyvinyl Chloride and Copolymer Resins | | | | | | | All Other Vinyl Resins | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Film | Sheeting | Molding & Extrusion | Textile & Paper Treating | Flooring | Protective Coatings | All Other Uses | Adhesives | All Other Uses | Grand Total |
| 1953 | 63,691 | 62,385 | 129,215 | 52,353 | 22,152 | 22,823 | 27,790 | 22,411 | 77,478 | 480,299 |
| 1954 | 69,943 | 56,588 | 147,284 | 49,546 | 34,890 | 23,676 | 35,148 | 26,609 | 74,090 | 517,773 |
| 1955 | 83,276 | 51,424 | 183,736 | 64,223 | 56,357 | 27,439 | 53,868 | 31,853 | 105,644 | 657,821 |
| 1956 | 78,063 | 55,598 | 206,726 | 62,931 | 65,384 | 28,522 | 71,859 | 36,565 | 115,151 | 720,799 |
| 1957 | 90,543 | 56,344 | 216,517 | 66,392 | 81,357 | 31,519 | 50,637 | 41,665 | 113,396 | 748,370 |
| 1958 | 72,404 | 67,594 | 214,701 | 63,050 | 113,583 | 28,913 | 68,307 | 52,904 | 117,752 | 801,208 |
| 1958: | | | | | | | | | | |
| May | 5,534 | 5,331 | 15,958 | 4,769 | 10,347 | 2,518 | 5,519 | 3,675 | 9,149 | 64,800 |
| June | 5,986 | 5,716 | 16,205 | 5,462 | 9,117 | 2,518 | 4,020 | 3,932 | 9,399 | 62,355 |
| July | 4,796 | 5,330 | 15,520 | 4,883 | 8,093 | 2,526 | 3,860 | 4,381 | 4,362 | 53,751 |
| Aug. | 6,594 | 5,547 | 19,286 | 6,245 | 10,530 | 2,810 | 6,002 | 9,194 | 9,497 | 75,705 |
| Sept. | 6,696 | 6,971 | 20,029 | 6,194 | 10,340 | 2,370 | 7,236 | 4,308 | 11,349 | 75,493 |
| Oct. | 7,358 | 6,975 | 23,989 | 7,116 | 11,555 | 2,528 | 8,580 | 4,859 | 13,560 | 86,520 |
| Nov. | 5,760 | 6,431 | 20,239 | 6,024 | 9,938 | 2,134 | 7,227 | 4,015 | 10,439 | 72,207 |
| Dec. | 5,954 | 7,871 | 22,162 | 6,110 | 9,843 | 1,996 | 9,376 | 3,815 | 11,292 | 78,419 |
| 1959: | | | | | | | | | | |
| Jan. | 5,959 | 8,050 | 23,818 | 5,139 | 11,708 | 2,442 | 5,988 | 3,533 | 12,648 | 79,285 |
| Feb. | 5,590 | 9,094 | 22,638 | 5,052 | 11,176 | 2,325 | 7,312 | 4,139 | 12,601 | 79,927 |
| Mar. | 7,088 | 8,735 | 25,086 | 5,514 | 13,568 | 2,537 | 8,014 | 4,919 | 14,257 | 89,718 |
| Apr. | 7,526 | 10,390 | 27,226 | 5,951 | 14,096 | 3,038 | 8,376 | 5,182 | 15,282 | 97,067 |

Source: Chemical Division, U. S. Tariff Commission.

# DCI MAGNESIA PRODUCTS

*can help you get HIGH QUALITY End Products*

ANALYSIS OF DCI MAGNESIAS

| | DCI Magnesium Oxide Light TECHNICAL | DCI Magnesium Oxide Medium TECHNICAL E-3 | DCI Magnesium Oxide Heavy TECHNICAL | DCI Magnesium Oxide Heavy TECHNICAL | DCI Magnesium Carbonate TECHNICAL | DCI Magnesium Hydroxide N. F. & TECHNICAL |
|---|---|---|---|---|---|---|
| Product No. | 1001 | 7001 | 4001-4002 | 8001 | 2001 | 3001 |
| Bulk Density weight per cu. ft. | Powder 9 lbs Granular 5 lbs | 20 lbs | 20 - 26 lbs | 40 lbs | 9 lbs | 13 lbs |
| Ignition loss | 5.0 % | 6.0% | 4.0% | 4.0 % | 57.16% | |
| ANALYSIS: IGNITED BASIS | | | | | | |
| $SiO_2$ | 0.04% | 0.4% | 0.7% | 2.4 % | 0.11% | 0.03% |
| $Fe_2O_3$ | 0.03% | 0.2% | 0.4% | 0.07% | 0.02% | 0.02% |
| $AL_2O_3$ | 0.11% | 0.1% | 0.1% | 0.04% | 0.03% | 0.06% |
| CaO | 1.36% | 1.3% | 1.4% | 0.49% | 0.30% | 0.94% |
| SCREEN TEST | | | | | | |
| thru 200 mesh | 100% | 100% | 93% or | | 100% | 100% |
| thru 325 mesh | 99.9% | 99.5% | 99.5% | 99% | 99.9% | 99.9% |

For free technical assistance and price information regarding DCI Magnesia Compounds, be sure to get in touch with . . . . . .
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Kingsley 5-5426

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*Mfrs. of Slitters, Web Guides, Rewinding and Constant Tension Equipment*

# Rubber Industry Employment Earnings and Hours

## All Rubber Products

| Mo. | 1958 Production Workers (thousands) | 1958 Average Weekly Earnings | 1958 Average Weekly Hours | 1958 Average Hourly Earnings | 1959 Production Workers (thousands) | 1959 Average Weekly Earnings | 1959 Average Weekly Hours | 1959 Average Hourly Earnings |
|---|---|---|---|---|---|---|---|---|
| Jan. | 200.9 | $87.48 | 38.2 | $2.29 | 199.1 | $100.28 | 41.1 | $2.44 |
| Feb. | 191.3 | 85.04 | 37.3 | 2.28 | 198.6 | 101.75 | 41.7 | 2.44 |
| Mar. | 184.0 | 87.02 | 38.0 | 2.29 | 200.6 | ..... | ... | ... |
| Apr. | 176.0 | 85.88 | 37.5 | 2.29 | .... | ..... | ... | ... |
| May | 172.3 | 87.86 | 38.2 | 2.30 | .... | ..... | ... | ... |
| June | 175.8 | 91.10 | 39.1 | 2.33 | .... | ..... | ... | ... |
| July | 175.1 | 91.89 | 39.1 | 2.35 | .... | ..... | ... | ... |
| Aug. | 181.2 | 96.80 | 40.5 | 2.39 | .... | ..... | ... | ... |
| Sept. | 187.5 | 97.51 | 40.8 | 2.39 | .... | ..... | ... | ... |
| Oct. | 194.5 | 97.27 | 40.7 | 2.39 | .... | ..... | ... | ... |
| Nov. | 195.3 | 98.09 | 40.7 | 2.41 | .... | ..... | ... | ... |
| Dec. | 198.2 | 102.66 | 41.9 | 2.45 | .... | ..... | ... | ... |

## Tires and Tubes

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Jan. | 81.6 | 98.52 | 36.9 | 2.67 | 76.9 | 117.55 | 41.1 | 2.86 |
| Feb. | 78.5 | 93.02 | 36.1 | 2.65 | 75.7 | 119.68 | 41.7 | 2.87 |
| Mar. | 76.0 | 98.05 | 37.0 | 2.65 | .... | ..... | ... | ... |
| Apr. | 72.1 | 95.67 | 36.1 | 2.65 | .... | ..... | ... | ... |
| May | 70.4 | 99.48 | 37.4 | 2.66 | .... | ..... | ... | ... |
| June | 71.2 | 103.63 | 38.1 | 2.72 | .... | ..... | ... | ... |
| July | 71.0 | 106.59 | 38.9 | 2.74 | .... | ..... | ... | ... |
| Aug. | 72.5 | 113.96 | 40.7 | 2.80 | .... | ..... | ... | ... |
| Sept. | 74.1 | 113.40 | 40.5 | 2.80 | .... | ..... | ... | ... |
| Oct. | 75.3 | 113.24 | 40.3 | 2.81 | .... | ..... | ... | ... |
| Nov. | 76.2 | 115.75 | 40.9 | 2.83 | .... | ..... | ... | ... |
| Dec. | 77.1 | 121.40 | 42.2 | 2.87 | .... | ..... | ... | ... |

## Rubber Footwear

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Jan. | 17.5 | 74.87 | 39.2 | 1.91 | 17.1 | 78.20 | 39.9 | 1.96 |
| Feb. | 17.0 | 74.68 | 39.1 | 1.91 | 17.1 | 80.78 | 40.8 | 1.98 |
| Mar. | 16.7 | 76.61 | 39.9 | 1.92 | .... | ..... | ... | ... |
| Apr. | 16.5 | 75.46 | 39.3 | 1.92 | .... | ..... | ... | ... |
| May | 16.3 | 75.85 | 39.3 | 1.93 | .... | ..... | ... | ... |
| June | 16.3 | 11.20 | 40.0 | 1.93 | .... | ..... | ... | ... |
| July | 15.9 | 75.25 | 39.4 | 1.91 | .... | ..... | ... | ... |
| Aug. | 16.4 | 77.18 | 40.2 | 1.92 | .... | ..... | ... | ... |
| Sept. | 16.8 | 76.62 | 39.7 | 1.93 | .... | ..... | ... | ... |
| Oct. | 17.1 | 77.01 | 39.9 | 1.93 | .... | ..... | ... | ... |
| Nov. | 17.2 | 77.22 | 39.6 | 1.95 | .... | ..... | ... | ... |
| Dec. | 17.1 | 78.01 | 39.8 | 1.96 | .... | ..... | ... | ... |

## All Other Rubber Products

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Jan. | 101.8 | 80.94 | 39.1 | 2.07 | 105.1 | 91.27 | 41.3 | 2.21 |
| Feb. | 95.8 | 80.32 | 38.8 | 2.07 | 105.8 | 91.96 | 41.8 | 2.20 |
| Mar. | 91.3 | 79.87 | 38.4 | 2.08 | .... | ..... | ... | ... |
| Apr. | 87.4 | 79.87 | 38.4 | 2.08 | .... | ..... | ... | ... |
| May | 85.6 | 80.29 | 38.6 | 2.08 | .... | ..... | ... | ... |
| June | 88.3 | 83.77 | 39.7 | 2.11 | .... | ..... | ... | ... |
| July | 88.2 | 82.92 | 39.3 | 2.11 | .... | ..... | ... | ... |
| Aug. | 92.3 | 86.24 | 40.3 | 2.14 | .... | ..... | ... | ... |
| Sept. | 96.6 | 89.21 | 41.3 | 2.16 | .... | ..... | ... | ... |
| Oct. | 102.1 | 88.78 | 41.1 | 2.16 | .... | ..... | ... | ... |
| Nov. | 101.9 | 88.54 | 40.8 | 2.17 | .... | ..... | ... | ... |
| Dec. | 104.0 | 92.60 | 41.9 | 2.21 | .... | ..... | ... | ... |

Source: U. S. Department of Labor.

Note: Data are based upon reports from cooperating establishments covering both full and part-time employees who work during, or received pay for, any part of the pay period ending nearest the 15th of the month. These employment series have been adjusted to first quarter 1954 benchmark levels indicated by data from government social insurance programs. Hours and earnings data pertain only to production and related workers.

# Spot Closing Cotton Prices

*(Middling Upland Grade—New York Market—in Cents)*

## Average Monthly Price Per Pound

| | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 |
|---|---|---|---|---|---|---|---|---|
| Jan. | 42.96 | 33.24 | 34.16 | 35.07 | 35.24 | 34.82 | 36.31 | 35.67 |
| Feb. | 41.64 | 33.76 | 35.00 | 35.04 | 36.26 | 34.82 | 35.83 | 35.69 |
| Mar. | 41.70 | 34.10 | 35.23 | 34.33 | 36.70 | 35.35 | 36.05 | 35.71 |
| Apr. | 41.79 | 33.85 | 35.22 | 34.23 | 36.43 | 35.43 | 36.00 | 36.05 |
| May | 39.98 | 34.30 | 35.34 | 34.80 | 36.65 | 35.40 | 36.27 | 36.24 |
| June | 41.31 | 34.11 | 35.17 | 34.83 | 36.67 | 35.45 | 36.33 | 36.05 |
| July | 40.37 | 34.20 | 35.37 | 34.61 | 35.43 | 35.49 | 36.51 | .... |
| Aug. | 40.42 | 33.82 | 35.19 | 34.53 | 34.31 | 35.15 | 36.36 | .... |
| Sept. | 39.75 | 33.69 | 35.46 | 33.85 | 34.35 | 34.74 | 36.00 | .... |
| Oct. | 37.52 | 33.53 | 35.24 | 33.93 | 34.45 | 35.09 | 36.23 | .... |
| Nov. | 35.59 | 33.60 | 34.80 | 34.87 | 34.56 | 36.06 | 36.24 | .... |
| Dec. | 33.76 | 33.52 | 35.03 | 34.95 | 34.56 | 36.50 | 35.75 | .... |
| Average for Year | 39.71 | 33.81 | 35.10 | 34.59 | 35.50 | 35.36 | 36.16 | .... |

Note: The Government established a ceiling of 45.76c for spot cotton on March 3, 1951. (a) Trading suspended during February.

# Production Index for the Rubber Industry

## (1947-1949 = 100)

## (Based on man-hours)

| | 1957 | 1958 | 1959 | | 1957 | 1958 | 1959 |
|---|---|---|---|---|---|---|---|
| Jan. | 145 | 116 | 142 | July | 136 | 125 | ... |
| Feb. | 141 | 114 | 150 | Aug. | 141 | 131 | ... |
| Mar. | 145 | 116 | 156 | Sept. | 138 | 136 | ... |
| Apr. | 132 | 112 | 135 | Oct. | 135 | 133 | ... |
| May | 134 | 113 | ... | Nov. | 131 | 141 | ... |
| June | 135 | 125 | ... | Dec. | 117 | 140 | ... |

# Sales by the Rubber Industry

## (in Millions of Dollars*)

| | 1957 | 1958 | 1959 | | 1957 | 1958 | 1959 |
|---|---|---|---|---|---|---|---|
| Jan. | 496 | 448 | 508 | July | 514 | 478 | ... |
| Feb. | 495 | 413 | 490 | Aug. | 514 | 438 | ... |
| Mar. | 476 | 396 | 506 | Sept. | 481 | 464 | ... |
| Apr. | 490 | 429 | ... | Oct. | 490 | 493 | ... |
| May | 481 | 428 | ... | Nov. | 431 | 472 | ... |
| June | 458 | 445 | ... | Dec. | 427 | 518 | ... |

# Rubber Manufacturers' Inventories

## (in Millions of Dollars*)

| | 1957 | 1958 | 1959 | | 1957 | 1958 | 1959 |
|---|---|---|---|---|---|---|---|
| Jan. | 1,047 | 1,100 | 1,013 | July | 1,045 | 980 | ... |
| Feb. | 1,036 | 1,087 | 1,032 | Aug. | 1,074 | 1,024 | ... |
| Mar. | 1,030 | 1,069 | 1,030 | Sept. | 1,074 | 1,024 | ... |
| Apr. | 1,031 | 1,047 | .... | Oct. | 1,097 | 1,022 | ... |
| May | 1,024 | 1,020 | .... | Nov. | 1,101 | 1,018 | ... |
| June | 1,027 | 986 | .... | Dec. | 1,092 | 994 | ... |

Source: U. S. Department of Commerce.
Notes: * Adjusted for seasonal variation.

# No. 1 R.S.S.—Annual Average Prices

*(New York Market—Cents per Pound)*

| Year | High | Low | Avg. | Year | High | Low | Avg. |
|---|---|---|---|---|---|---|---|
| 1917 | 90 | 52 | 72.23 | 1938 | 17⅞ | 10¼ | 14.64 |
| 1918 | 70 | 40 | 60.15 | 1939 | 24 | 14⅜ | 17.57 |
| 1919 | 57 | 38½ | 48.70 | 1940 | 24 | 18¾ | 20.10 |
| 1920 | 56½ | 16 | 36.30 | 1941 | 24⅞ | 19⅛ | 22.40 |
| 1921 | 21¾ | 11½ | 16.36 | 1942 | 22½ | 22½ | 22.50 |
| 1922 | 28⅜ | 13⅝ | 17.50 | 1943 | 22½ | 22½ | 22.50 |
| 1923 | 37⅞ | 24¾ | 29.45 | 1944 | 22½ | 22½ | 22.50 |
| 1924 | 40⅞ | 17⅝ | 26.20 | 1945 | 22½ | 22½ | 22.50 |
| 1925 | 121 | 34⅜ | 72.46 | 1946 | 22½ | 22½ | 22.50 |
| 1926 | 88½ | 36¾ | 48.50 | 1947 | 25 | 14 | 20.00 |
| 1927 | 41¾ | 33 | 37.72 | 1948 | 25 | 18 | 21.99 |
| 1928 | 41¼ | 17 | 22.48 | 1949 | 19¾ | 15⅞ | 17.57 |
| 1929 | 26⅞ | 15½ | 20.55 | 1950 | 86 | 18 | 41.10 |
| 1930 | 16½ | 7½ | 11.98 | 1951 | 76 | 52 | (a) |
| 1931 | 8⅝ | 4¼ | 6.17 | 1952* | 33 | 26½ | 29.15 |
| 1932 | 4¾ | 2½ | 3.49 | 1953 | 31⅞ | 19⅞ | 24.21 |
| 1933 | 9⅞ | 2⅝ | 5.96 | 1954 | 34½ | 19½ | 23.61 |
| 1934 | 15⅞ | 8¾ | 12.92 | 1955 | 52 | 29⅜ | 39.16 |
| 1935 | 13¾ | 10½ | 12.37 | 1956 | 45 | 26½ | 34.24 |
| 1936 | 23 | 13½ | 16.41 | 1957 | 37¾ | 26⅝ | 31.13 |
| 1937 | 26⅞ | 14 | 19.39 | 1958 | 32⅝ | 24⅝ | 28.13 |

Note: Price was fixed by Government on August 6, 1941, at 22½c a pound for non-war uses. Free trading was resumed May 1, 1947. (a) Free trading suspended March 31, 1951. GSA selling price ranged between 52 and 66c during balance of year. * Free trading was resumed on July 1, 1952; figures represent only July through December, 1952.

# No. 1 R.S.S.—Monthly Average Prices

*(New York Market—Cents per pound)*

| | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 |
|---|---|---|---|---|---|---|---|---|
| Jan. | .... | 29.40 | 20.22 | 33.92 | 41.70 | 33.32 | 27.15 | 30.34 |
| Feb. | .... | 27.57 | 19.98 | 34.90 | 33.68 | 30.43 | 26.32 | 30.26 |
| Mar. | .... | 26.59 | 20.16 | 31.08 | 33.68 | 31.76 | 26.65 | 31.62 |
| Apr. | .... | 24.66 | 22.06 | 31.75 | 31.74 | 32.23 | 26.44 | 33.72 |
| May | .... | 25.52 | 21.96 | 31.35 | 29.61 | 32.12 | 25.51 | 36.48 |
| June | .... | 24.42 | 23.01 | 34.74 | 30.54 | 32.80 | (26.20 | 34.31 |
| July | 30.52 | 23.64 | 24.12 | 40.84 | 33.91 | 32.88 | 27.70 | .... |
| Aug. | 29.36 | 23.36 | 23.26 | 45.85 | 35.69 | 32.13 | 28.72 | .... |
| Sept. | 27.42 | 23.06 | 23.99 | 48.27 | 32.64 | 29.94 | 29.49 | .... |
| Oct. | 27.26 | 20.82 | 26.57 | 43.81 | 32.68 | 29.24 | 31.06 | .... |
| Nov. | 29.25 | 20.58 | 28.07 | 44.95 | 35.18 | 27.47 | 32.10 | .... |
| Dec. | 31.26 | 20.92 | 29.88 | 48.40 | 37.01 | 29.25 | 30.28 | .... |
| Average for Year | 29.15 | 24.21 | 23.61 | 39.16 | 34.24 | 31.13 | 28.13 | .... |

Note: (a) Free trading suspended March 31, 1951, and resumed on July 1, 1952.

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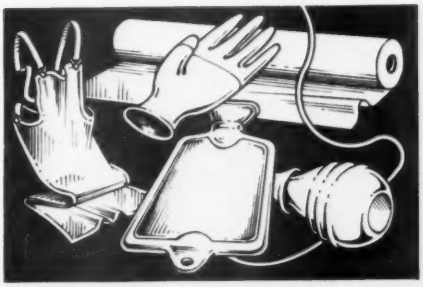

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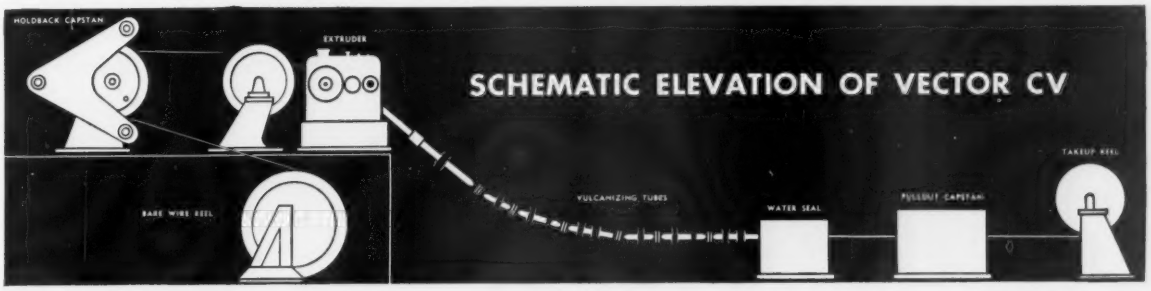


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| Hyde Park 2430 - 0456 | SHerwood 2-8262 | BLackstone 3-9222 | TOpaz 1-0371 | (56) 2130 - 2149 |

## Various Compounding Materials Consumed by the Rubber Industry

| Material | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 |
|---|---|---|---|---|---|---|---|
| Antimony, Primary | | | | | | | |
| Short tons | 19c | 66c | 20c | 49c | 78 | 156 | 284 |
| % of total | .001 | .004 | .001 | .004 | .006 | .010 | .024 |
| Asphalt: [a] | | | | | | | |
| Short tons | 21,414 | 33,288 | ..... | ..... | .. .. | ..... | ..... |
| % of total | 0.3 | 0.4 | ..... | ..... | ..... | ..... | ..... |
| Barite (Barytes): | | | | | | | |
| Short tons | 15,000 | 18,000 | 21,009 | 20,000 | 25,104 | 22,101 | 21,782 |
| % of total | 2.13 | 2.0 | 2.0 | 2.0 | 2.0 | 2.0 | 1.0 |
| Carbon Black: | | | | | | | |
| Short tons | 530,614 | 537,273 | 566,797 | 511,813 | 643,430 | 622,325 | 635,781 |
| % of total | 93.9 | 93.1 | 94.4 | 93.5 | 93.5 | 95.5 | 95.5 |
| Clay, Kaolin: | | | | | | | |
| Short tons | 231,331 | 240,982 | 241,052 | 247,431 | 257,223 | 268,157 | 301,185 |
| % of total | 12.7 | 13.2 | 12.8 | 13.2 | 11.9 | 12.0 | 14.0 |
| Clay, Fire & Stoneware: | | | | | | | |
| Short tons | ..... | 9,322 | 18,475 | 8,781 | 2,928 | .. .. | ..... |
| % of total | ..... | 0.1 | .2 | .1 | .2 | .... | ..... |
| Lime: | | | | | | | |
| Short tons | 1,126 | 2,000 | 1,631 | 1,555 | 1,465 | 2,487 | 2,799 |
| % of total | (d) | (d) | (d) | (d) | (d) | (d) | (d) |
| Litharge: | | | | | | | |
| Short tons | 2,641 | 2,109 | 2,230 | 1,768 | 1,947 | 2,266 | 1,898 |
| % of total | 1.1 | 1.5 | 1.4 | 1.3 | 1.3 | 1.7 | 1.7 |
| Lithopone: | | | | | | | |
| Short tons | 3,295 | 1,523 | 1,723 | 1,701 | 2,163 | 2,000[e] | .... |
| % of total | 3.2 | 2.5 | 3.3 | 3.9 | 5.0 | 5.0 | .... |
| Mica, Ground: | | | | | | | |
| Short tons | 6,551 | 5,126 | 5,668 | 5,021 | 7,339 | 7,021 | 8,579 |
| % of total | 9.0 | 7.0 | 7.8 | 6.3 | 6.9 | 8.0 | 9.0 |
| Sulfur: | | | | | | | |
| Short tons | 84,000 | 84,000 | 89,600 | 84,000 | 89,600 | 89,600 | 89,600[e] |
| % of total | 1.4 | 1.4 | 1.4 | 1.3 | 1.2 | 1.1 | 1.1 |
| Talc: [b] | | | | | | | |
| Short tons | 70,970 | 64,476 | 61,408 | 58,139 | 38,309 | 30,253 | 28,532 |
| % of total | 11.2 | 10.9 | 10.0 | 9.7 | 5.4 | 5.0 | 6.0 |
| Zinc Oxide: | | | | | | | |
| Short tons | 71,507 | 72,774 | 78,439 | 71,058 | 86,677 | 80,459 | 81,745 |
| % of total | 48.4 | 51.2 | 52.7 | 50.7 | 51.5 | 51.9 | 54.0 |

Source: U. S. Bureau of Mines.

Notes: (a) Solid and semi-solid products of less than 200 penetration. (b) Includes prophyllite and ground soapstone. (c) Does not include precipitated antimony sulfide as in previous years. (d) Negligible. (e) Estimated.

## Reclaimed Rubber

### (Including Natural and Synthetic)

*(All Quantities in Long Tons)*

| Year | New Supply | Consumption: Tons | Consumption: % to Crude [a] | Exports | Stocks On Hand at End of Period |
|---|---|---|---|---|---|
| 1941 | 274,202 | 251,231 | 32.2 | 13,851 | 41,750 |
| 1942 | 286,00/ [b] | 254,820 | 64.6 | 30,405 | 42,532 |
| 1943 | 304,058 [c] | 291,082 | 59.6 | 15,678 | 46,201 |
| 1944 | 260,631 [d] | 251,083 | 35.3 | 11,800 | 43,832 |
| 1945 | 243,309 | 241,036 | 30.2 | 13,413 | 28,155 |
| 1946 | 295,612 | 275,410 | 26.5 | 14,461 | 33,666 |
| 1947 | 291,395 | 288,395 | 24.8 | 14,556 | 35,943 |
| 1948 | 266,861 | 261,113 | 24.4 | 11,428 | 32,630 |
| 1949 | 224,029 | 226,679 | 22.5 | 10,637 | 28,263 |
| 1950 | 314,008 | 303,733 | 24.1 | 11,740 | 35,708 |
| 1951 | 366,700 | 346,121 | 26.6 | 14,722 | 45,082 |
| 1952 | 274,981 | 280,002 | 22.2 | 11,180 | 30,664 |
| 1953 | 298,336 | 285,050 | 21.3 | 11,597 | 32,319 |
| 1954 | 258,101 | 249,049 | 20.2 | 10,232 | 30,746 |
| 1955 | 326,649 | 312,781 | 20.4 | 13,988 | 31,498 |
| 1956 | 287,220 | 270,547 | 18.8 | 13,832 | 34,969 |
| 1957 | 271,647 | 267,352 | 18.2 | 13,021 | 29,323 |
| 1958 | 259,809 | 248,156 | 18.2 | 11,362 | 29,063 |
| 1958: | | | | | |
| Feb. | 19,017 | 18,130 | 18.0 | 665 | 28,838 |
| Mar. | 20,225 | 19,300 | 18.5 | 1,012 | 28,984 |
| Apr. | 20,735 | 19,746 | 19.1 | 832 | 29,440 |
| May | 19,601 | 20,104 | 19.6 | 1,012 | 27,862 |
| June | 21,230 | 20,652 | 19.2 | 1,024 | 27,763 |
| July | 18,136 | 18,350 | 18.2 | 1,087 | 26,442 |
| Aug. | 22,432 | 19,347 | 17.4 | 900 | 27,961 |
| Sept. | 22,641 | 21,771 | 17.7 | 1,005 | 26,676 |
| Oct. | 26,554 | 23,563 | 17.2 | 1,028 | 27,340 |
| Nov. | 22,450 | 21,271 | 17.4 | 1,051 | 27,680 |
| Dec. | 24,830 | 23,285 | 17.5 | 841 | 29,063 |
| 1959: | | | | | |
| Jan. | 25,790 | 25,002 | 17.9 | 1,157 | 27,157 |
| Feb. | 25,290 | 24,471 | 18.2 | 1,041 | 27,504 |
| Mar. | 29,310 | 27,869 | 18.8 | .... | 27,582 |

Source: U. S. Bureau of Mines.

Notes: (a) Solid and semi-solid products of less than 200 penetration. (b) Includes prophyllite and ground soapstone. (c) Does not include precipitated antimony sulfide as in previous years. (d) Negligible. (e) Estimated.

## Cotton, Rayon and Nylon Tire Fabrics

*(In Thousands of Pounds)*

| | Production: Rayon Tire Cord Net Woven | Production: Rayon Tire Cord Woven | Production: Cotton and Nylon Cord & Fabric [a] | Production: Chafer Fabrics (all fibers) | Production: Total Tire Cord and Fabric | Stocks [b]: Cotton and Nylon Cord & Fabric | Stocks [b]: Rayon Cord and Fabric |
|---|---|---|---|---|---|---|---|
| 1957: | | | | | | | |
| Jan.-Mar. | 21,853 | 68,825 | 31,393 | 11,028 | 123,182 | 11,844 | 37,153 |
| Apr.-June | 16,037 | 63,195 | 35,308 | 10,456 | 115,418 | 13,428 | 13,473 |
| July-Sept. | 10,509 | 54,968 | 33,477 | 9,147 | 100,091 | 13,305 | 36,388 |
| Oct.-Dec. | 9,216 | 58,392 | 32,827 | 10,176 | 101,687 | 14,909 | 29,632 |
| Total | 57,615 | 245,380 | 133,005 | 40,807 | 440,378 | 53,486 | 116,646 |
| 1958: | | | | | | | |
| Jan.-Mar. | 8,372 | 56,522 | 25,647 | 7,367 | 92,924 | 11,255 | 33,913 |
| Apr.-June | ..... | ..... | 30,745 | 6,020 | 80,533 | 11,274 | 26,327 |
| July-Sept. | ..... | ..... | 31,371 | 6,467 | 91,984 | 11,229 | 26,428 |
| Oct.-Dec. | ..... | ..... | 34,858 | 8,466 | 107,352 | 12,251 | 25,936 |
| Total | 8,372 | 56,522 | 122,621 | 28,320 | 372,793 | 46,009 | 112,604 |

Source: Bureau of the Census, U. S. Department of Commerce.

Notes: (a) Combined to avoid disclosing figures for individual companies. (b) At end of period.

## Gasoline Consumption

*(In Thousands of Barrels of 42 Gallons)*

| | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 |
|---|---|---|---|---|---|---|---|
| Jan. | 89,634 | 89,634 | 96,397 | 100,642 | 109,295 | 107,281 | 114,720 |
| Feb. | 86,458 | 86,206 | 88,464 | 98,088 | 96,694 | 95,516 | 99,759 |
| Mar. | 98,158 | 101,549 | 105,684 | 112,412 | 113,166 | 108,914 | 118,995 |
| Apr. | 102,044 | 103,866 | 111,116 | 113,034 | 115,820 | 118,477 | ..... |
| May | 105,918 | 104,418 | 115,707 | 123,560 | 124,325 | 125,137 | ..... |
| June | 114,703 | 113,037 | 120,710 | 126,833 | 121,598 | 125,444 | ..... |
| July | 112,969 | 112,231 | 115,653 | 120,708 | 130,251 | 130,903 | ..... |
| Aug. | 109,124 | 110,223 | 121,816 | 125,847 | 128,808 | 129,925 | ..... |
| Sept. | 106,158 | 104,706 | 113,379 | 111,574 | 113,567 | 120,389 | ..... |
| Oct. | 106,037 | 105,607 | 112,558 | 119,204 | 119,334 | 125,097 | ..... |
| Nov. | 99,210 | 102,393 | 109,212 | 112,113 | 107,705 | 110,587 | ..... |
| Dec. | 100,225 | 104,258 | 111,034 | 108,096 | 112,691 | 120,305 | ..... |
| Total | 1,230,629 | 1,238,346 | 1,321,730 | 1,372,116 | 1,393,254 | 1,417,975 | |

Source: U. S. Bureau of Mines.

## U. S. Gross Imports of Balata, Jelutong, Gutta-Percha, etc.

*(All Quantities in Long Tons)*

| Year | Balata: Tons | Balata: Value | Jelutong: Tons | Jelutong: Value | Gutta-Percha & Other Guttas: Tons | Gutta-Percha & Other Guttas: Value |
|---|---|---|---|---|---|---|
| 1945 | 1,361 | 907,253 | .... | ..... | 36 | 21,970 |
| 1946 | 2,281 | 2,233,065 | 304 | 256,169 | 423 | 458,064 |
| 1947 | 1,982 | 2,276,531 | 2,878 | 1,496,887 | 392 | 779,591 |
| 1948 | 1,195 | 805,078 | 3,401 | 2,377,765 | 423 | 542,788 |
| 1949 | 1,391 | 814,554 | 1,043 | 834,978 | 197 | 189,021 |
| 1950 | 2,117 | 1,589,885 | 1,789 | 1,515,162 | 541 | 745,418 |
| 1951 | 2,452 | 1,973,271 | 1,669 | 2,608,359 | 383 | 430,539 |
| 1952 | 988 | 762,994 | 1,636 | 2,094,983 | 282 | 385,890 |
| 1953 | 1,619 | 866,248 | 1,027 | 1,166,837 | 235 | 303,116 |
| 1954 | 949 | 504,065 | 2,196 | 2,624,926 | 417 | 511,055 |
| 1955 | 1,022 | 967,369 | 1,679 | 1,731,821 | 284 | 318,115 |
| 1956 | 1,396 | 1,111,165 | 1,851 | 1,909,447 | 290 | 309,615 |
| 1957 | 1,037 | 670,821 | 1,680 | 1,942,067 | 230 | 270,487 |
| 1958 | 745 | 536,820 | 1,501 | 1,698,840 | 157 | 224,499 |
| 1958: | | | | | | |
| Sept. | 97 | 29,775 | 129 | 189,219 | 13 | 10,199 |
| Oct. | 39 | 83,128 | 165 | 123,167 | 6 | 16,300 |
| Nov. | 107 | 90,763 | 119 | 150,300 | ... | ..... |
| Dec. | 119 | 103,432 | 192 | 220,972 | 5 | 6,786 |
| 1959: | | | | | | |
| Jan. | 132 | 132,210 | 175 | 205,421 | 12 | 16,860 |
| Feb. | 49 | 41,650 | 104 | 121,702 | 7 | 8,439 |
| Mar. | 97 | 86,358 | 160 | 223,653 | 27 | 31,735 |

Source: U. S. Department of Commerce.

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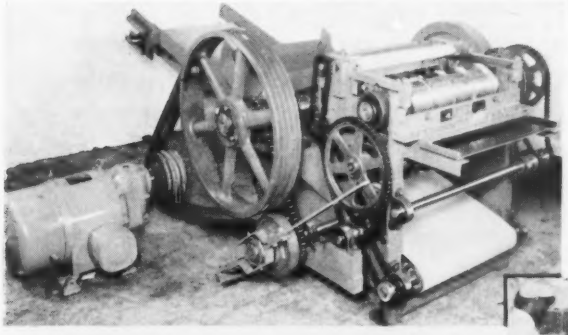

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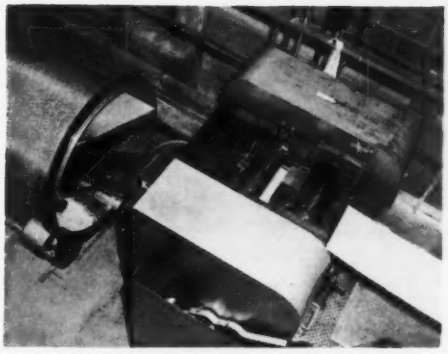

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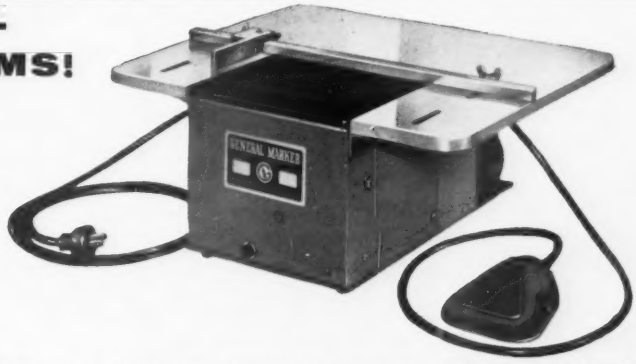

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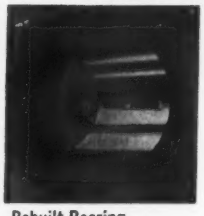

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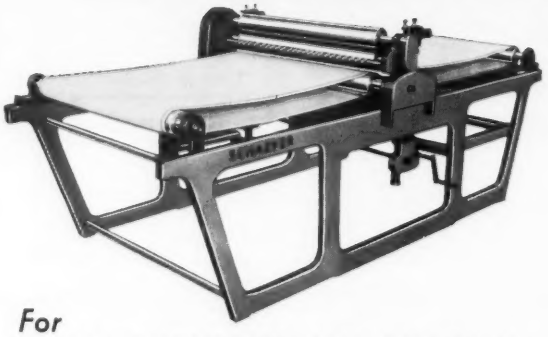

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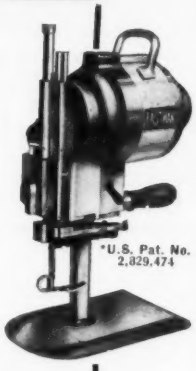

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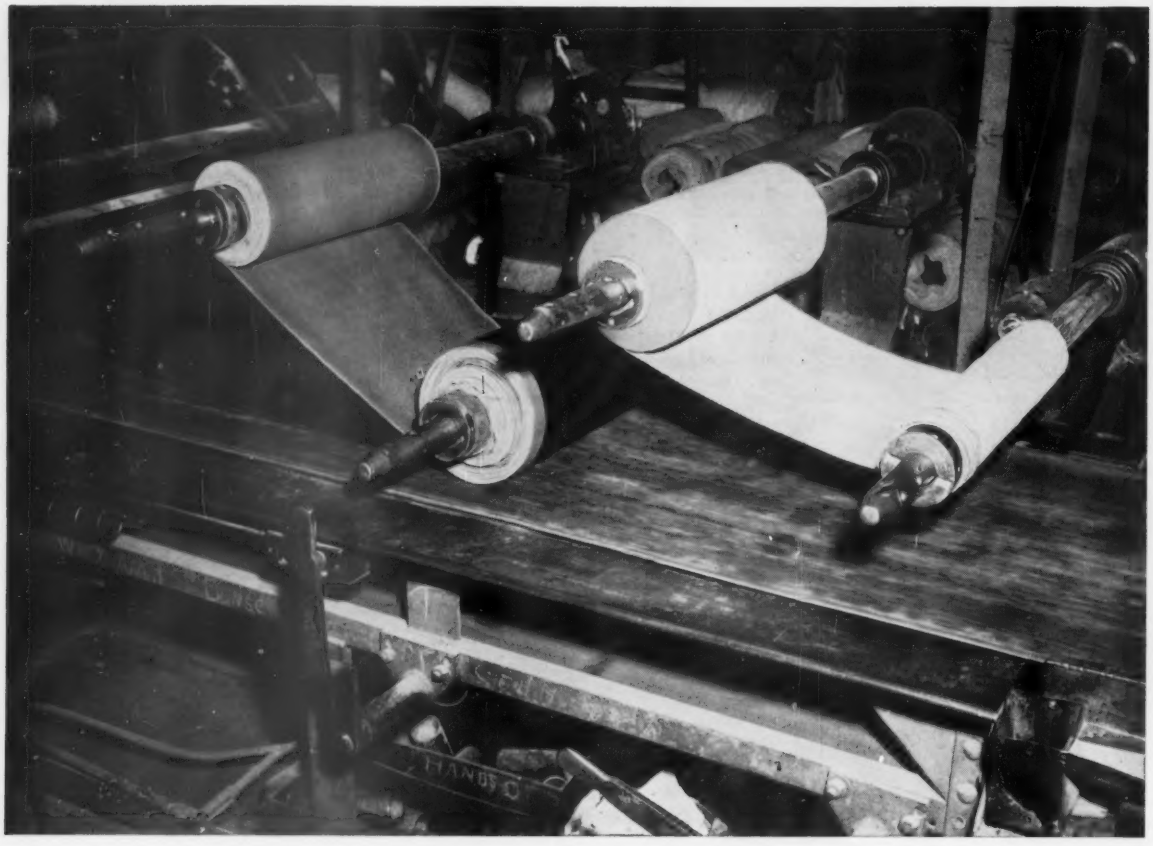

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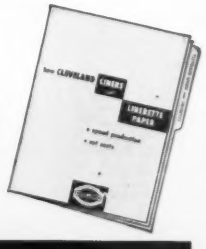


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AUGUST, 1959

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